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FEBRUARY 1, 1955

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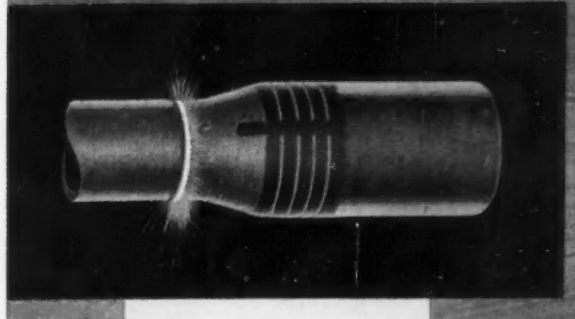

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WORLD OIL

Established 1916 as The OIL WEEKLY

Vol. 140, No. 2

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a quick look at WORLD OIL THIS MONTH

BUSY OIL MEN: To help you put first things first, scan these time-saving digests on this and the following pages, checking ☑ those you want to read first.

CURRENT OUTLOOK ARTICLES

☐ **The outlook for 1955.** U. S. producers of crude oil and natural gas liquids will have markets for more production in 1955 than in 1954. Demand for petroleum products will be up. Crude runs to stills also will need to be higher. These prospects are indicated by the recently-published Bureau of Mines forecast of supply and demand in 1955. Domestic production of crude will need to be 3.1 percent higher in 1955 than in 1954; output of natural gas liquids 4.8 percent higher. These increases will be justified despite an expected increase of 5.9 percent in total imports. The estimates are based on the forecast of a 3.1 percent increase in total demand for all oils in 1955. Domestic consumption will be up 4.0 percent, it is estimated. But this gain will be cancelled partially by a decrease of 16.4 percent in exports. See **Page 39. More Crude Needed to Meet 1955 Demand ... L. J. Logan**

Turn the Page ➧

THIS MONTH . . .

☐ **Just how profitable** are additions to domestic oil and gas reserves? While operations are worthwhile over-all, are the older and lower-cost reserves "carrying" the newer reserves? Turn to **Page 43** for an approach to the answer of this highly-important consideration. **How Profitable Are Additions to U. S. Oil and Gas Reserves?.....Dr. Othel D. Westfall**

☐ **Are you buying brains wisely?** Here, from the dean of college recruiters, are some tips on enlisting the best minds from college campuses—and, no less valuable, an analysis of the value and purpose of the recruiting programs. **Page 49. A College Recruiter's Yardstick for Job Candidates. An Interview by Robert E. Spann with Paul W. Boynton**

☐ **Expanding sales in a tough competitive market** is the continuous aim of oil men and oil companies. One of their major allies is scientific research. Turn to **Page 52** for a summary of what one research institute is doing and who supports it. **Research Is One of the Industry's Greatest Allies.....Anthony Gibbon**

☐ **It could mean new power** for O. A. (Jack) Knight and his Oil Workers International Union if the AFL-CIO merger becomes a fact. The chances for such a merger are considered good. George Meany of the AFL says prospects for unity are brighter than ever before. For an over-all look at the fast assembling union mosaic read **AFL-CIO Merger Could Boost Fortunes of Oil Union Head.....Page 59**

☐ **Are you underestimating your losses** through pilferage? You know, of course, that the problem involves more than dollar loss. Management with a do-nothing attitude is inviting employes to brand it a "soft touch." On the other hand, you will be wise to avoid the iron-fisted approach. Here are some pointers on a tactful solution. **You Can Stop Pilferage..Page 60**

EXPLORATION ARTICLES

☐ **Here's a detailed description,** illustrated with actual curves and examples of field results, of one of the newest type of formation logging or correlation. Already in use on a commercial basis, the technique involves analysis of formation cuttings, the latter taken

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THIS MONTH . . .

without necessity of shutting down drilling operations. Analysis of mineral content of cuttings, instead of paleontological specimens, gives accurate data on formation changes, faults, etc. The resulting log strips, of the same size and scale as existing electric and radiation logs, are easily compared and correlated. DTA logs minimize, to a large degree, human element and individual differences in interpretation. See **Page 77. DTA—a New Type of Formation Correlation (Part 1)**.....**George B. Mangold**

☐ **Accurate interpretation of gravity meter data** can reveal subsurface structural conditions responsible for mapped gravity anomalies. Geologist W. R. Sype selects examples in relatively unexplored areas to point this out. Application of techniques described in the article beginning on **Page 82** will promote more accurate interpretation of gravity meter data. **Gravity Data Indicate Structural Conditions**.....**W. R. Sype**

DRILLING ARTICLES

☐ **Some questions have been raised.** Air drilling promises to reduce drilling costs in many areas. But where can it be used? What air volumes and pressures are needed? What about the equipment market? WORLD OIL interviewed compressor manufacturers, bit manufacturers, and operators now using the technique. From them come the answers to...**The Questions Most Often Asked About Air and Gas Drilling**.....**Page 111**

☐ **One thing is certain**—water is a deterrent to air drilling. It is going to take some imagination to conquer this problem. Here are some suggested techniques and equipment aimed at solving this and other problems. These questions are answered:

- How to seal off zones?
- What volumes of water can be coped with?
- How can you tell when water is encountered?

Here are some new **Air Drilling Ideas That May Pay Off**.....**Page 117**

☐ **What about compressor equipment?** Air compressors and the horsepower requirement are important to contractors who are trying to adapt them to their rigs. See the arrangements now contemplated. **What You Should Know About Equipment**.....**Pages 120-121**

☐ **Do bits drill the same with air as with mud?** And more important do formations drill the same? Leading bit companies were asked to answer these questions. Here is some information that explains..**How Bits Drill With Air**.....**Page 122**

☐ **What about explosions?** Two companies have experienced mild explosions and three underground fires have been reported. Dr. Eugene Poncelet of Stanford Research Institute was asked to evaluate this hazard. He predicts negligible damage because of low detonation pressure developed. **Can Explosions Occur Underground?**.....**Page 126**

☐ **Aerated mud is a bright** spot on the horizon as far as air drilling performance is concerned. Some feel it will have wider application than straight air or gas drilling because it can be used to drill through wet zones without excessive trouble and yet offers the penetration benefits of air. **How Does Aerated Mud Technique Differ?**.....**Page 130**

PRODUCTION ARTICLES

☐ **More profit from production** you already have is what you can get in most cases by the application of a new idea in everyday oil field operation and maintenance. In factories they call it "time and motion" studies. Here it's technically called "time and methods" studies. A critical analysis of your operation and maintenance setup may reveal how you can reorganize crews, reassign responsibilities, and redesign transportation units to fit the job. It has been done in a number of cases and resulted in savings up to $70,000 per year in one case. It may apply to you. Turn to **Page 147** for the full story. **Job Analyses Pay Dividends**...**Harold S. Kelly and Rogers C. Filson**

☐ **Sweep efficiencies of the staggered line-drive pattern** is governed to a large extent by the radius of the fracture. This is a prime observation resulting from a laboratory study on horizontal fracturing thin formations which are water-flooded or gas cycled. Conclusions of a series of potentiometric studies involving different fractures radii and varying well spacing are presented on **Page 154** in the sixth of series on **Water-Flooding and Gas Cycling Affected by Horizontal Fractures in Thin Reservoirs**....**Dr. Paul B. Crawford**

☐ **Get more oil from that depleted reservoir** by extending the drainage area around the well. How can this be done without drilling a new well? Numerous wells have been worked over in California and the Gulf Coast area by horizontal drilling from the original bore. Equipment and techniques have been

Turn the Page ➧

THIS MONTH . . .

proven in original completions for a number of years. Now their use in workovers promises to bring about even greater recoveries. Turn to **Page 158** for more details and illustrations. **Horizontal Drainhole Techniques Applied to Workover Problems . . . Carl O. Spath**

☐ **Giant pressure maintenance project** injects 137 million cubic feet of gas daily. Production of oil was immediately stepped up 50 percent, and ultimate recovery is to be increased by 33 percent. This is what Creole Petroleum Corporation has placed in operation in one of its Bolivar Coastal fields on the eastern edge of Lake Maracaibo in Venezuela. Recently dedicated was the largest compressor station of its kind to compress the gas to nearly 2000 pounds per square inch. The plant alone cost $20 million. For more details read **Giant Pressure Maintenance Project Begun in Venezuela . . . . . Page 166**

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INTERNATIONAL ARTICLES

☐ **A Camp City Profile.** Playing a major oil industry role while plying their water routes, tankers are "floating camps" which add their own aura of interest to the industry. Turn to **Page 181** for a quick look at life aboard a tanker. **Tanker Men Are Proud Men . . . . . George N. Hebert**

☐ **Offshore Safety.** A course in swimming is a recommended safety precaution for oil companies with offshore and over-water operations. Creole Petroleum Corporation instituted swimming instructions for all of its employes engaged in over-water operations after drownings continued to be the most common industrial fatality despite elaborate safety measures. See **Page 184** for the type of instruction program used by Creole for its employes in the Lake Maracaibo area of Venezuela. **Offshore Safety . . . . . Clifford G. Janney**

☐ **Papua's long-term prospects** are regarded by Australian government authorities as superior to those of the Australian mainland. Hopes are continuing to run high as two principal operating companies push efforts to test in and above the Cretaceous. Turn to **Page 188. Hopes High as Papuan Exploration Moves Along . . . . . Don Kliewer**

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PETROLEUM REFINER and THE REFINERY CATALOG for the refining-natural gasoline-petrochemical industry.
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Looking Ahead . . .

. . . **A first quarter demand increase of 330,000 barrels** daily over the like period of 1954 was predicted by the Independent Petroleum Association of America. Needs for all oils during the first quarter will be 8.9 million barrels daily, IPAA forecast. This would be 385,000 barrels daily more than in the last quarter of 1954. IPAA also said scheduled imports during the first quarter will average 1.25 million barrels daily, up 9 percent or 101,000 barrels daily over the fourth period of last year.

. . . **25,000 engineering and scientific students** would receive $2000 a year each under a federal subsidy proposal made by Rep. Adam Clayton Powell, Jr. (D-N.Y.). Powell calls for $50 million a year to keep the U. S. abreast of Russia in the race for technological superiority. He declared: "Within five years our military leadership with the atom bomb and the hydrogen bomb will be completely wiped out by the Soviet's overpowering scientific and engineering leadership."

. . . **Military purchases of oil products** for fiscal 1956 will increase by 6 to 7 percent, officials indicated. Dollar outlay, however, will remain at about $1 billion, due to likelihood that purchases of higher priced items such as aviation gasoline will decline slightly.

. . . **1955 will be one of the four best years** the steel industry has ever had. This is the opinion of W. W. Sebald, president of Armco Steel Corporation, who predicted a production rise of at least 10 percent over last year.

. . . **Whether a state can rightfully assess an income tax** against production from federal lands will be decided by a federal court at Denver. Case arose from a 1953 Colorado law under which $2.5 million has been paid, $1,827,061 of it under protest. The California Company is taking the case to federal court after Colorado Revenue Department upheld its income tax division's refusal to refund $955,238 gross income tax paid by the company.

. . . **The highest gasoline tax rate** in the U. S. may be imposed in Oregon. Proposal is to hike the rate from 6 to 8 cents a gallon with the aim of providing $8-10 million additional revenue for roads. Oregon, in 1919, was the first state to enact a gasoline tax.

. . . **Growing popularity of LPG** is expected to show a much greater percentage increase in 1955, barring unseasonably warm weather conditions. The 1954 increase was held down to 4.1 percent over the 1953 volume but established an all-time sales high of 5.1 billion gallons.

. . . **A new effort will be made** in this Congress to earmark funds from offshore oil leases for federal aid to schools. Sen. Hill (D-Ala.), who tried unsuccessfully to push an "oil for education" bill through the 1953 session, said more than $144 million has come into the federal treasury from such leases during the past few months. "That money should be put to work to help meet the financial crisis of our schools and colleges."

. . . **Democrats may push minimum wage** up to $1. It has long been considered a foregone conclusion that the 75-cent minimum would be hiked, but the most-talked figure has been 90 cents.

. . . **The Engineers and Scientists of America,** which now claims to represent 40,000 engineers and scientists in 20 states, is again prepared to support a Taft-Hartley amendment offered unsuccessfully last year by Senator Humphrey of Minnesota. The amendment would bring supervisory employes, among them thousands of engineers, under the collective bargaining section.

SLURRY OIL SQUEEZE

New DOWELL SERVICE is designed to control water production in oil and gas wells

SOS* (Slurry Oil Squeeze) is a new Dowell cementing service designed to stop undesirable water production quickly. It has proven highly effective in both oil and gas wells in almost every type of formation.

The slurry used in SOS consists of portland cement, a special Dowell surface tension reducing agent, and a non-aqueous carrying medium like diesel oil or kerosene. The cement will not set up in the presence of the non-aqueous carrying medium or the crude oil contacted in the pay. It will readily set up when contacted by formation water.

The entire batch of SOS slurry is pre-mixed in truck-mounted, paddle-mixing tanks. This method provides a smooth oil-cement slurry of any density the operator desires. Then high-pressure, triplex pumps are used to inject the slurry into the formation.

Here's proof that SOS pays off! Dowell engineers were called when a well tested several hundred barrels of salt water daily, with only a trace of oil. After SOS, the well produced 40 BOPD and no water. Another well was producing 30 BOPD and 30 BWPD. An SOS treatment stopped all water production. The well still made 30 BOPD.

For full information on Slurry Oil Squeeze call your nearest Dowell office or write DOWELL INCORPORATED, Tulsa 1, Oklahoma, Dept. B-13.

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Death Notice for Free Enterprise

Many important questions confront the new Congress of the United States. In wrestling with these matters, it is to be hoped that Congress does not overlook the question of government control of natural gas prices. This also is extremely important. While obviously an exceedingly important problem for the oil and gas industry, actually the basic principles involved make it a matter of great concern to every American citizen.

Basically the issue involves this country's system of government and business enterprise as known since the beginning of the U. S. The outcome will constitute one of the most historic constitutional questions in American history. Therefore it will affect a great many businesses and every American citizen.

It is urgent that action be taken at this session of Congress, because of the recent imposition by the U. S. Supreme Court of federal government price regulation over natural gas sold by producers to interstate pipe line companies.

•

Truly frightening implications arise from imposition of government control of prices received by natural gas producers.

If gas prices are to be government-controlled, the way has been paved for the regulation of producers' prices on all commodities. Every basic product in existence enters interstate commerce. It logically follows that the producers' prices for wheat, corn, cotton, coal, copper, steel and other basic commodities also are likely to be regulated.

The natural gas business is no different from the pattern of most other commodities. Producers produce and gather the gas for sale to transmission companies. The latter ship the gas cross-country and wholesale it to local distributors, who retail it to the customers. Ranchers are the producers of cattle. They raise the cattle, gather them, and sell them to packing houses. Packers process them and wholesale the meat to stores which retail it to consumers.

Even if government regulation is limited to things used by public utilities, the next step would be to regulate the price of large quantities of coal and oil used in generating electricity. For that matter, why shouldn't everything a utility uses be subject to the same regulation, whether wire, generators, automobiles, typewriters or what-have-you?

•

A sweeping change thus is indicated in the relationship between U. S. business and government.

Government control of producers' prices would be a long, long step in the direction of Socialism. This would mark the approaching end of the American free enterprise business system unless corrected at once.

There is no basis for departing from America's long-established successful competitive system—unless the people of this country want to replace American tradition and philosophy with Socialism.

The American people must decide now between two philosophies: whether they (1) want to adopt Socialism or (2) want to preserve and perpetuate the American way of life for coming generations.

The only sure way to remedy the situation is for the American people to see that Congress passes corrective legislation that will prevent the first step toward Socialism from becoming effective.

Warren L. Baker

More Crude Needed to Meet 1955 Demand

• Total demand to be up 3.1 percent, with domestic use up 4 percent but exports off 16.4 percent.

• Markets to absorb production increases of 3.1 percent for crude, 4.8 percent for natural gasoline.

• Higher domestic operations indicated in spite of expected increase of 5.9 percent in imports.

By L. J. LOGAN, WORLD OIL Staff

INCREASED OIL SUPPLIES will be required in 1955 and the domestic operations of the industry will have to be stepped up accordingly. An increase of 3.1 percent is anticipated in total demand for all oils in 1955 as compared with 1954.

This is the outlook offered by the recently published Bureau of Mines forecast of supply and demand for 1955. The forecast in the Bureau's Monthly Petroleum Forecast No. 234 covers the month of January, 1955, and the complete year of 1955. Also included are figures on supply and demand for 1954, partly estimated.

Domestic producers will have markets in 1955 for 3.1 percent more crude petroleum and 4.8 percent more natural gas liquids than their estimated production in 1954.

Higher domestic operations are indicated in spite of an expected increase of 5.9 percent in total imports. The imports of crude will be up 7.5 percent and imports of refined products will be 3.4 percent higher.

The above estimates of supplies which will provide a balance with demand assume no change during the year in the level of crude oil stocks and allow for a moderate net increase of 22,000 barrels daily average in the stocks of refined products.

The predicted 3.1 percent increase in the 1955 total demand for all oils represents the aggregate effect of varying indicated increases for the different products. The largest expected gain is that of 4.9 percent for distillate fuel oil total demand, while other anticipated increases include those of 2.5 percent for gasoline, 1.6 percent for kerosine, 0.9 percent for residual fuel oil, and 5.6 percent for all other oils combined.

If the industry makes only a moderate net addition to stocks of refined products in 1955, as assumed in the forecast, U. S. crude runs to still will need to be only 3.1 percent higher than in 1954 to meet market requirements of refined products.

Gain in 1954 small. Although the expected increase in petroleum demand in 1955 is moderate, it will be an improvement over the small gain of only 0.8 percent in total demand for all oils in 1954. That increase included a gain of only 1.5 percent in domestic demand and a decline of 12.7 percent in total exports. The gain of 0.8 percent in total demand in 1954 was the aggregate result of increases of 1.9 percent for gasoline, 4.9 percent for distillate fuel oil, 1.1 percent for kerosine, and 2.6 percent for all other oils except residual fuel oil, which showed a decrease of 6.5 percent, due to lower use by railroads and public utility electric power plants and smaller needs for bunkering ships.

Estimated crude production of 1954 was 1.9 percent less than in 1953, and crude runs to stills were down 0.7 percent.

Stocks of domestic crude declined about 15 million barrels in 1954, and stocks of other oils probably showed a small gain, compared with an increase of 49 million barrels in 1953.

—The End

U. S. Bureau of Mines 1955 Forecast of Supply and Demand

MILLIONS OF BARRELS

ITEM	Est. 1954 Year	FORECAST, 1955, BY QUARTERS				Forecast 1955 Year	Percent Diff. 1954-1955
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter		
Production, Total	**2,561.0**	**654.0**	**650.0**	**668.0**	**673.0**	**2,645.0**	**+ 3.3**
Crude	2,314.0	590.0	588.0	603.0	605.0	2,386.0	+ 3.1
Other Oils	247.0	64.0	62.0	65.0	68.0	259.0	+ 4.8
Imports, Total	**388.0**	**109.0**	**97.0**	**96.0**	**109.0**	**411.0**	**+ 5.9**
Crude	240.0	65.0	63.0	64.0	66.0	258.0	+ 7.5
Refined	148.0	44.0	34.0	32.0	43.0	153.0	+ 3.4
New Supply	**2,949.0**	**763.0**	**747.0**	**764.0**	**782.0**	**3,056.0**	**+ 3.6**
Change in Stocks	**—7.0**	**—41.0**	**+35.0**	**+43.0**	**—29.0**	**+8.0**	.....
Crude	—14.5	.....	.....	.....	.....	.....	.....
Products	+7.5	—41.0	+35.0	+43.0	—29.0	+8.0	.....
Total Demand	**2,956.0**	**804.0**	**712.0**	**721.0**	**811.0**	**3,048.0**	**+ 3.1**
Motor Fuel	1,268.0	291.0	340.0	347.0	322.0	1,300.0	+ 2.5
Residual	553.0	158.0	128.0	121.0	151.0	558.0	+ 0.9
Distillate	547.0	201.0	105.0	97.0	171.0	574.0	+ 4.9
Kerosine	123.0	46.0	18.0	19.0	42.0	125.0	+ 1.6
All Other	465.0	108.0	121.0	137.0	125.0	491.0	+ 5.6
Exports, Total	**128.0**	**27.0**	**30.0**	**26.0**	**24.0**	**107.0**	**— 16.4**
Crude	13.0	3.0	3.0	2.5	2.5	11.0	— 15.4
Refined	115.0	24.0	27.0	23.5	21.5	96.0	— 16.5
Domestic Demand	**2,828.0**	**777.0**	**682.0**	**695.0**	**787.0**	**2,941.0**	**+ 4.0**
Motor Fuel	1,233.0	284.0	332.0	340.0	316.0	1,272.0	+ 3.2
Residual	527.0	153.0	123.0	117.0	147.0	540.0	+ 2.5
Distillate	524.0	196.0	99.0	92.0	167.0	554.0	+ 5.7
Kerosine	118.0	45.0	17.0	18.0	41.0	121.0	+ 2.5
All Other	426.0	99.0	111.0	128.0	116.0	454.0	+ 6.6
Daily Averages (Thousands of Barrels)							
Total Production	7,017	7,267	7,143	7,261	7,315	7,247	+ 3.3
Imports	1,063	1,211	1,066	1,043	1,185	1,126	+ 5.9
Change in Stocks	—19	—455	385	467	—315	22	.....
Total Demand	8,099	8,933	7,824	7,837	8,815	8,351	+ 3.1
Exports	351	300	330	283	261	293	— 16.5
Domestic Demand	7,748	8,633	7,494	7,554	8,554	8,058	+ 4.0
Runs to Stills	6,950	7,190	7,070	7,175	7,211	7,162	+ 3.1
Demand for Domestic Crude	6,382	6,556	6,462	6,554	6,576	6,537	+ 2.4

How Profitable Are Additions To U. S. Oil and Gas Reserves?

Though domestic operations are worthwhile over-all, are your older and lower-cost reserves "carrying" the newer reserves?

By **DR. OTHEL D. WESTFALL,**
Professor of Accounting, University of Oklahoma

POSTWAR DEVELOPMENT of new domestic oil and gas reserves has been recognized as a contribution to the national security. And the federal government has encouraged such investment by allowing immediate partial recovery through tax saving by means of the intangible drilling and development cost option coupled with the percentage depletion allowance.

But it does not necessarily follow that the remainder of the investment has been profitable, or as profitable as other investment would have been. It seems generally conceded that per barrel costs of new domestic reserves are on an upward trend, even after allowing for dollar devaluation. The domestic industry is faced with competition from foreign reserves, with proration of oil production and with regulation of the price of gas.

New oil production capacity does not bring a commensurate increase in total allowable production, but each new well adds to operating expenses. Even though domestic operations may be profitable over-all, it is possible that the older and lower-cost reserves are "carrying" the newer reserves.

Obviously, the question thus raised can be answered only by separately evaluating the profitability of the older and more recent investment in developed oil and gas reserves in terms of rate of return on investment, and by comparing the two results. Such an evaluation and comparison, coupled with appraisal of the effects of foreseeable changes in conditions, should serve as the basis for decision on further development of domestic oil and gas reserves. Logically, management would expect the accounting department to report rates of return on investment, by properties, without undue difficulty.

But conventional accounting procedures for oil and gas production, though they may serve well the purposes for which they were designed, do not provide a ready means for making such computations. It is the primary purpose of this paper to present the problems involved and to suggest ways and means for their solution.

It should be recognized that there are certain intangible or speculative values in new development which cannot be measured with any degree of certainty. Because of proration, new productive capacity initially may be in part excess or idle capacity and in part a displacement of the allowable on older properties. Without new development by the individual concern, however, its allowable production on older properties might nevertheless be forced down through expansion by more aggressive competitors.

Thus, additional development may be the only means of maintaining present relative position in the market, although future position might be protected more or less by holding undeveloped properties. As a further consideration, idle capacity gradually becomes producing capacity, as potential approaches allowable, and might become producing capacity overnight in case of war. So idle capacity has some speculative value.

This speculative value should be greater in the case of integrated companies which, in case of war, might not otherwise have sources of crude sufficient to maintain refining and marketing operations at profitable levels. None of these remarks is intended to imply that idle and producing capacity can be evaluated separately. There is in fact only one property. These intangible or speculative considerations mean merely that total investment in the property may be more valuable than current return would indicate. How much more is a matter of judgment.

Why is it that the accountants are not readily able to report rate of return on investment by producing properties?

One reason is that accountants early recognize the hazardous nature of petroleum exploration and development operations and, with management approval, have consistently offset a large part of new investment against current income from previously developed properties. Thus, conventional accounting tends to assure that we "keep ahead of the game" on an over-all basis, but it does not accumulate total investment in new properties. By and large, this philosophy has been recognized also for tax purposes, for which the accountants deserve no small share of the credit.

Another reason is that with investment and return given, determination of the rate is not a matter of simple division. Investment in a producing property is normally a declining balance due to depletion and depreciation, and simple division would produce a distorted rate. If rate of return on investment is to provide a basis for decision, the rate must be realistic. If management wants this information accountants will provide it, but with considerable deviation from conventional procedures and undoubtedly at added cost.

Problems involved may be summarized by the following questions, which will serve as guides for subsequent discussion:

- What property unit should be selected?
- What is investment for rate-of-return purposes?
- What is return?
- How should return be related to investment?

Conceivably, the property unit selected for rate-of-return purposes might be the lease, the field, the production district, the production division, or the entire production operation. The last three can be quickly ruled out for investment—decision

purposes because each would embrace both old and new properties and would not provide desired comparison.

The lease is probably too small a unit to be significant, and selection of this unit would unnecessarily multiply the work to be done.

By elimination the field is selected as the most desirable property unit for purposes of comparing rate of return on investment as between older and newer properties. For more reliable comparisons, it may be desirable to group fields by age and to compute an average or composite rate of return for each age group. The rates can be computed by fiscal years or from beginning to date.

The question as to what constitutes investment in a field is, perhaps, most troublesome one of all. As a starting point, there should be little question as to inclusion of amounts presently carried as leasehold cost, intangible development cost, and equipment cost in producing properties. But this is merely a starting point.

Additional questions which arise include the following:

1. Should field investment include an allocable portion of those costs which have been expensed but which were originally incurred with the objective of adding to reserves? These costs include such items as cost of surrendered or expired leases, delay rentals, exploration cost, dry-hole and bottom-hole contributions, and dry-hole costs.

2. Should field investment be reduced by the tax saving on investment items expensed for tax purposes?

3. Should investment be reduced by the estimated salvage value of equipment?

4. Should accumulated depletion and depreciation be deducted?

5. Should field investment be increased by an allocable portion of investment in field service, district, division, and general office facilities?

6. Should working capital be allocated to fields?

7. Should original cost be adjusted for price level change?

8. Should investment be segregated or allocated between oil and gas?

With reference to investment items which have been expensed, it might be argued that current expenditures would about equal the amortization which would be currently deductible if prior expenditures of the same nature had been originally capitalized. That is a very dubious proposition, and particularly so since a special method of amortization is indicated for rate-of-return purposes, as will later be explained.

But even if the point were conceded, the fact remains that expenditures of this nature conventionally are not treated as property operating expense and are not allocated to producing properties. So, since allocation is still necessary, it would seem better to allocate the expenditures as additional investment. No implication is intended that any such allocation should be spread upon the books. In fact, no immediate change in conventional accounting procedures is contemplated in this paper.

Perhaps the simplest allocation method for expensed investment is to spread all expenditures of this nature for a given year over additions to proven reserves for that year. Yet, most of the items bear little relation, in terms of cause and effect, to current additions to proven reserves.

Furthermore, additions to reserves may include revisions of reserves added in prior years as well as estimates of newly-added reserves. But even if expensed investment were spread over estimates of newly-added reserves alone, such estimates are subject to radical subsequent revision and are thus an unstable basis over which to spread capital expenditures. Since each year is a separate entity for budgeting or planning purposes and since levels of activities and costs fluctuate from year to year, it seems appropriate that expensed investment for each year should be allocated separately.

Ideally, however, expensed investment for each year should be allocated to properties participating in such investment which that year, or later, become productive. This does not mean that all of the expensed investment for the year should be placed in one pot and allocated together.

It is suggested that the expensed investment be classified along the following lines:

- Acquisition cost (a substitute for surrendered lease cost as explained below).
- Lease maintenance cost (delay rentals and taxes, if any, on undeveloped properties).
- Exploration cost (geological, geophysical and geochemical).
- Development cost (dry holes, dry-hole contributions and bottom-hole contributions).

With reference to the first classification immediately above, conventionally, surrendered lease cost is recognized in the year of lease surrender rather than in the year when the cost was incurred. It is suggested that surrendered lease cost be recognized each year, on the basis of experience, as a fraction or percentage of leasehold acquisition expenditures.

Perhaps a three-year moving average of acreage surrendered to acreage acquired would be an appropriate experience basis. Following substitution of such an estimate for surrendered least cost as booked, the estimate should be allocated over acreage acquired for the respective year which ultimately becomes productive. Lease maintenance cost should be allocated over acreage on which rentals and taxes were paid which ultimately becomes productive. Exploration cost should be spread over acreage explored that ultimately becomes productive.

Of course, acreage which "ultimately becomes productive" may not be known, especially for recent years, but estimates can be made on the basis of experience. Development cost should be spread over the intangible drilling and development cost of productive wells for the year, except to the extent that such costs can readily be identified with specific properties from payout records or other sources. All of these allocations should be made statistically, possibly by geographical areas instead of on a company-wide basis, and may then be applied to any field for which rate of return is to be computed.

It seems self-evident that investment should be reduced by the amount of income taxes saved as the result of expensing part of the investment for tax purposes. This should apply to the allocations of investment previously expensed for financial purposes, as well as to capitalize intangible drilling and development cost.

Investment should also be reduced for the estimated salvage value of equipment, if material in amount. However, the estimated future value should be discounted to present value before reducing the investment because investment in salvage value should also earn a return. Rate of dis-

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count will necessarily be arbitrary, but it should approximate what could be earned by investing the same amount of money elsewhere. Possibly a uniform fixed rate, of say 6 percent, would be most practicable.

Accumulated depletion and depreciation should be deducted from investment but not as conventionally determined. This point will be amplified later.

The question logically arises as to whether field investment should not include an allocable portion of investment in field service units, district office facilities and general office facilities. Presumably, all this investment plays an essential part in the ultimate extraction of reserves, and must be recovered from that source. Conventionally, depreciation on such investment along with other overheads is allocated down to the lease level for tax purpose, but not necessarily so for financial purposes. Allocation of this investment to fields, for rate-of-return purposes is not suggested because there is no fixed relationship between this investment and the fields benefited.

Benefits from this investment flow to fields in varying ratios from year to year, and may even flow in part to outside interests. Annual allocation of depreciation and other overhead takes these varying ratios into account, and thus is a more equitable treatment. But since allocation is usually made at cost, except perhaps to outsiders, any return on investment in the facilities under consideration would be merged with return on investment in the producing properties.

As a result, return on field investment might thus be overstated. This result might be avoided by charging producing properties for services rendered at commercial rates, or at rates which would include a fair return on investment in service facilities, in lieu of actual overhead.

Economists, or at least some of them, would argue that any overheads inherited from the past should be ignored in computing return on new field investment. Their theory is that the past costs which give rise to such overhead are "sunk"; that is, there is nothing management can do to avoid such overheads. This is a questionable assumption because the service facilities, or the use of them in whole or in part possibly could be sold to outsiders. It is also a "short run" point of view; in the "long run" the business must recover all costs or face financial difficulties.

It is evident that some working capital would be required to finance the current operation of a field or other producing property unit. And it would seem to be as reasonable to expect a return on the funds tied up for this purpose as it is to expect a return on funds invested in a relatively more permanent manner.

However, the amount of working capital associated with a particular property would not be fixed, and allocation of working capital to properties might be a continual problem. Assuming realization of the value of each month's production in the following month, however, the annual total of out-of-pocket property operating expenses divided by 12 might be a reasonable measure of working capital associated with the property.

In the case of integrated companies, realization probably would not occur in the following month, but the additional working capital required to finance deferment of realization should not be attributed to production. Working capital is, of course, neither depreciable nor depletable.

And as will be seen, depletion and depreciation of permanent investment is a prime problem in determining rate of return from producing properties. For this reason, it is suggested that working capital not be added to permanent investment but, instead, that income or return from the field be reduced by a fair charge (say 6 percent) for use of working capital.

Desirability of adjustment for the changing value of the dollar is a moot question in accounting and management circles. However, it would seem that permanent investment in a property which was made when the price level was substantially different should be adjusted to the current price level for rate-of-return purposes. Current income and out-of-pocket expenses relating to the property would be in current dollars.

What validity would there be in any conclusion drawn from comparing rate of return from such an older property, determined without adjustment of investment, with rate of return from a new property as to which all factors of return are expressed at or near current price levels?

Price indexes appear to be the most practicable means for effecting price level adjustments. But those who favor price level adjustments are divided between those who favor the use of special indexes for the adjustment of particular items and those who favor the use of one index for the adjustment of all items. Use of the Consumer Price Index on all items requiring adjustment is suggested for reasons which cannot be adequately developed within the limits of this paper. These reasons are already on record in a privately published monograph entitled Balance Sheet Price Level Analysis.

Inevitably, the question will arise as to whether investment in properties producing both oil and gas should be allocated between the two reserves. Assuming this step is to be taken, it follows that property operating expenses also will have to be allocated between the two products. These are the familiar problems of joint cost allocation to which there is no ideal solution.

It would be preferable, it appears, to convert the gas reserve into barrels, possibly on the basis of equivalence in thermal units, and thereafter treat the property as one unit. This procedure would automatically adjust to subsequent changes in the ratio of the two reserve estimates, whereas a prior allocation of investment would be insensitive to such changes.

The question of what is return from a producing property can be answered fairly readily. Determination should start with net income from the property per books. Depletion and depreciation per books should be added back, since the method for relating return to investment will provide for amortization of investment. If overheads have not been allocated to properties per books, allocation made for income tax purposes should be available and acceptable for rate-of-return purposes.

Of course, if commercial rates are to be used in lieu of overheads, as previously discussed, the adjustment of income per books will differ accordingly. A deduction should be made for a fair return on associated working capital, where the amount would be material. Return, and thus rate of return, may be determined either before or after income taxes.

Return and rate of return after taxes should be more significant in

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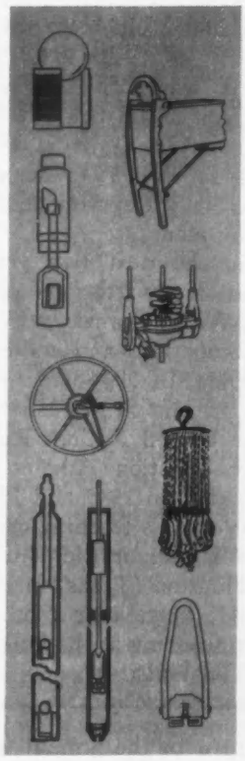

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considering investment alternatives, since income tax does not apply to oil and gas production in the same fashion that it applies to other industries. In computing income tax to be deducted from current property income, effect should be given not only to depletion and depreciation allowable for tax purposes but also to investment items expensed for tax purposes in the current year.

As a final consideration, return for prior years should be adjusted for price level change in computing average or cumulative rate of return from a property.

Following are possible methods or relating return to permanent investment, or of expressing return as a percentage of permanent investment:

1. Divide investment without reduction for accumulated depletion and depreciation into annual return before deduction of annual depletion and depreciation.
2. Divide 50 percent of investment without reduction for accumulated depletion and depreciation into annual return after deduction of annual depletion and depreciation.
3. Divide investment after deduction of accumulated depletion and depreciation into return after deduction of annual depletion and depreciation.
4. Divide annual depletion and depreciation into annual return after deduction of annual depletion and depreciation.
5. Divide the rate obtained in Method 4 by the number of years elapsed since date of investment.
6. Annuity method, using a simple rate of return.
7. Annuity method, using a compound rate of return.

It can be demonstrated that the first five of the methods listed above do not produce realistic results with respect to an isolated field or other property. The demonstration cannot be made within the limits of this paper. But it may be said generally that the methods ignore the time over which funds have been invested, and ignore the fact that annual return is related to the annual investment recovery rather than to some other fraction or percentage of investment.

Either of the annuity methods takes time into account and relates annual return to the annual amortization of investment although the annual amortization necessarily and properly differs from conventional depletion and depreciation. The simple rate of return would not be so easy to compute as the compound rate because tables and formulae are readily available for the latter.

Furthermore, compounding of the rate may be regarded as compensation for expense of reinvesting capital recoveries and for the time lag which occurs between recovery from one property and reinvestment in another. For these reasons compound rate method is preferred over the simple rate method.

The annuity principle, as adapted to rate-of-return purposes, means simply that permanent investment is the present value of that portion of the the series of annual returns from the property which is attributable to permanent investment. It will be recalled that suggestions for determination of annual return are designed to arrive at that portion of return, before allowance for exhaustion of principal, which is attributable to permanent investment.

If investment is divided by return for any year, the result is the present value of an annuity of $1 for an unknown number of years at a rate still unknown. If the estimated reserve at the beginning of the year is divided by production for the year, oil and gas being combined as previously suggested, the "presumptive life," or the number of years the field should produce at the current rate of production, is obtained.

With the present value of an annuity of $1 and the presumptive life of the field in years, both being derived from operating conditions which obtained during the current year, a table of present values of an annuity of $1 can be consulted for the rate of return or it can be determined by interpolation. If the presumptive life is not an integral number of periods, or if the rate sought is outside available present value tables, the rate may be determined by a trial-and-error process.

The process is to estimate the rate and, using the presumptive life, solve for the present value of an ordinary annuity of $1 in one of the standard present value formulas. The answer probably will not equal the known present value. Estimate another rate which should produce a result closer to the known present value, and solve again. Then interpolate or extrapolate between the two results to obtain the actual rate.

Use of logarithms will greatly speed up these trial solutions. The average accountant has long since grown "cold" on actuarial science and logarithms. But with a review of these subjects and a little practice it will be found that these calculations are

Continued on Page 50

About the Author

DR. OTHEL D. WESTFALL was graduated from the University of Oklahoma in 1931 with a B.S. degree in business. He received his degree of Master of Business Administration from Northwestern University in 1947 and his Ph.D. degree in Business Administration from the University of Texas in 1954.

During 1931-1933, Dr. Westfall was with Charles C. Porter Company, public accountants, Shawnee, Okla. A head deputy on examinations of cities, towns and schools for the office of State Examiner and Inspector in Oklahoma in 1933-1934, Dr. Westfall was affiliated with Farm Credit Administration, Washington, D. C., from 1934 to 1940. In 1940-1942 he was with the Navy Department, also at Washington.

During the next two years, Dr. Westfall was associated with Barrow, Wade, Guthrie & Company, accountants and auditors, Tulsa, Okla. In 1944 and 1945, he was in the army. He was with the United Nations Relief and Rehabilitation Administration, London, in 1945 and 1946.

Dr. Westfall's teaching career includes a post at the University of Houston (Texas) in 1946 and 1947. Since that time, he has been teaching at the University of Oklahoma.

A WORLD OIL Interview

with PAUL W. BOYNTON

Supervisor of Employment,

Socony-Vacuum Oil Company, Inc.

Boynton

Here's a College Recruiter's Yardstick for Job Candidates

By **ROBERT E. SPANN,**
WORLD OIL *Staff*

GREATER EMPHASIS has been placed upon recruiting job candidates direct from colleges in recent years. While recruiting has been done in this manner for about three decades the practice became widespread during World War II and the immediate postwar period. To learn something of the real value and purpose of these programs, WORLD OIL interviewed Paul W. Boynton, Supervisor of Employment for Socony-Vacuum Oil Company, Inc.

Boynton is the unofficial "dean" of the college recruiters, or ivory hunters, as they have been called. Boynton established the formal college recruiting program for Socony-Vacuum 25 years ago. Recruiting of personnel has been his career for more than 30 years, during which time he has interviewed more than 100,000 job applicants. Boynton's department annually averages interviewing more than 6000 applicants and answering letters from a total of 10,000 persons seeking employment.

Boynton's book, "Six Ways to Get a Job," is used in many high schools and colleges throughout the nation. He is also the author of "Selecting the New Employe" and "Six Ways to Retire."

Q. *Mr. Boynton, why do many companies have college recruiting programs?*

A. Theoretically, the colleges are a reservoir of the nation's best brains. Also, the distance the students can travel in search of employment is limited by financial reasons, so it became necessary for the industrial recruiter to go to the campus. Furthermore, it is desirable to broaden the geographic representation in the company.

Q. *Is there much competition between companies in hiring college graduates?*

A. Yes, indeed! It is estimated that between 4000 and 5000 companies now have college recruiting programs. The competition for men, particularly those in the upper third of the graduating classes, is rugged.

Q. *You indicate in your answer that there still is a shortage of college graduates. Is that true?*

A. Yes, in a few categories. For engineering graduates, for example, there are still about three times as many jobs as there are qualified applicants. The rate of increased enrollment in engineering schools indicates, however, that the number of graduates will become more in balance with job openings in about three years—barring any sudden shift in business conditions.

Q. *What types of job openings do you offer the college students?*

A. We are hiring across the board for nearly all of the departments in the company. Our largest number of openings are for engineers and non-technical sales trainees.

Q. *What type of person are you seeking to fill these jobs?*

A. We are looking for men who in 5 to 10 and 20 years hence will be able to fill executive positions in the company. I might add here that we do not feel that colleges have a monopoly on brains or that a man can't move up the ladder in this company unless he's a college graduate. Every employe is eligible for promotion according to his abilities and many non-college people have advanced to high executive positions.

Q. *How do you appraise applicants to find these future executives?*

A. One of the most important factors in the interviewer's appraisal is to determine whether the candidate can manage other people. This is equally important with technical ability. The best job candidate is an intelligent person who has had well rounded training. Participation in extracurricular activities is as important a factor as a good scholastic record. An experienced recruiter can look at a man's written record and pretty well determine what he will do and just about how far he will go in his career—barring any unusual emotional upsets. Any individual is the sum total of his experience to date, and if you would judge the future, it is wise to look into the past.

Q. *How many college students do you interview each year?*

A. We average interviewing between 1500 and 2000 students annually, although some of these are just seeking information to make comparisons with job openings in other companies.

Q. *About how many colleges do you visit each year?*

A. We visit about 75 colleges on the average, and sometimes it is as high as 100, depending on the number and type of jobs to be filled. These colleges are located all over the country. This year, for instance, Socony-Vacuum had four teams constantly in the field. Each team consisted of a trained college recruiter,

a personnel man from the area in which the team is working, and usually an operating manager in whose department vacancies exist.

Q. *How does the team operate in interviewing the students?*

A. First of all, the recruiting team does not hire an applicant on the spot. The team screens candidates in view of the job openings available and then recommends the best candidates to the various department managers where vacancies exist. After the screening interview which, incidentally, averages about 30 minutes, the successful candidates are asked by letter, normally within 10 days to two weeks, to go see a particular department head at company expense for a final interview. This gives an applicant a chance to learn something of the company and to see some of the people who may be his fellow workers. Also, it gives the company a better opportunity to size up the applicant. If the department head is satisfied, he then offers the student a job.

Q. *How do you determine if the recruiters are doing a proper job, that is, selecting the candidates that are best suited for the company?*

A. The only measure of our success is in the number of candidates that are actually hired by the company from those recommended. So far we've had about 90 percent of the recommended candidates hired by department managers.

Q. *How does a recruiter go about conducting a good interview?*

A. The recruiter to be a success should put himself in the candidate's shoes and remember the problems he faced in applying for a job. Then, too, a recruiter cannot expect the applicant to be able to state every reason why he should be hired. This must be drawn out by questions. In order to get those answers, a good interviewer should first make sure the job applicant feels at east. Next, the interviewer should determine the applicant's interests, and once his interests are established, the candidate will usually tell the interviewer all he needs to know. The candidate will either sell himself or hang himself by what he says.

Q. *Mr. Boynton, as a result of your long experience in selecting personnel, what advice can you offer job applicants?*

A. First, a man must want to work for a living. Secondly, he will only succeed to the extent of his abilities to sell himself . . . that is, a man should find the right job opportunity commensurate with his abilities and then sell the prospective employer that he is the best man for that job.

A job candidate should never rely on pull of friends or business associates in getting a job . . . it is proper to get a friend in a company to introduce the candidate to a department head or personnel manager, provided that after the introduction the candidate will stand on his own feet.

A job candidate is better off if he has a specific job in mind when applying to a company . . . the man willing to work at any job is a poor risk.

If it is not possible for the applicant to state a specific job, he should narrow his job interest to a specific field.

APPLICANT APPRAISAL

Here is the score card Paul W. Boynton keeps to help him size up a job candidate:

1. **Appearance and Health**
   - A. General Impression
   - B. Age
   - C. Physique
   - D. Hygiene
   - E. Physical Soundness
2. **Personal Attributes**
   - A. Voice
   - B. Speech Characteristics
   - C. Responsiveness
   - D. Maturity
   - E. Self-Confidence
   - F. Temperament
   - G. Social Acceptability
   - H. Attitudes
3. **Mental Alertness**
   - A. Scholastic Record—Activities
   - B. Type of Mind
   - C. Comprehension
   - D. Perseverance
   - E. Expression
   - F. Intellectual Curiosity
4. **Personal Interest**
   - A. High School and College
   - B. Community Activities
   - C. Hobbies
5. **Job and Career Interests**
   - A. Immediate Job Interests
   - B. Career Interests
   - C. Prospects of Career Realization
6. **Experience and Skills**
   - A. Education
   - B. Nature of Previous Jobs
   - C. Military Experience
   - D. Skills
7. **Work Habits**
   - A. Planning
   - B. Application
   - C. Cooperation

U.S. Oil/Gas Reserves

Continued from Page 48

neither difficult nor time consuming.

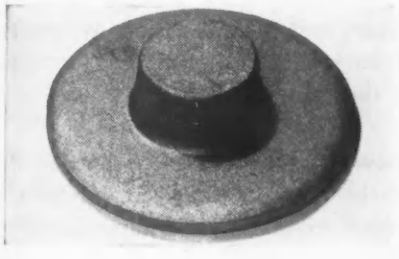
A cumulative or average rate of return for each field can also be determined. To do this, actual return for each year can be discounted at the previously determined rate of return for that year, compounded for the number of years of operation, to determine amortization of investment for that year.

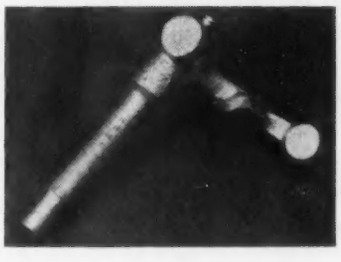
Amortization for each year should be adjusted to current price level, if price level adjustments are being made, and adjusted amortization for all years to date should be aggregated. Past annual returns should be adjusted to current price level, if price level adjustments are being made. By a trial and error process, it can then be determined what compound rate of return is required for discounting the annual returns so that aggregate of the discounted values will equal the total of investment amortization as previously determined. Two trials plus interpolation or extrapolation should be sufficient. Use of logarithms will speed up these calculations also.

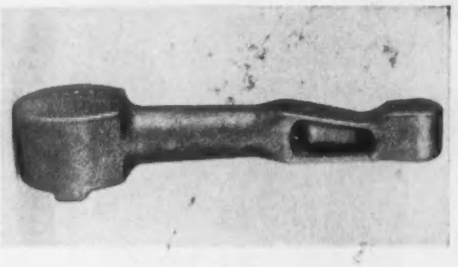
Composite rates of return for fields of the same age can readily be obtained, either by years or on an average-to-date basis. The process is to aggregate separately the annual returns and annual investment amortization, as previously determined for each field, by years. Composite annual return is the rate which equates aggregate annual return to aggregate annual investment amortization, compounding for the number of years of operation. This is also a trial-and-error process. Composite average or cumulative return is determined in the same fashion as average return for a single field, but with the use of aggregates.

There are, of course, various respects in which annual returns from an oil and gas property differ in some degree from an ordinary annuity. Space does not permit an enumeration of these differences, nor explanation of the steps which could be taken to compensate for them. However, the differences probably are not very material, although some of the compensatory steps might make the rate of return additionally valuable as an operating control instrument. —**The End**

Checking a 69-lb forging made on one of Bethlehem's 8000-lb steam hammers.







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BETHLEHEM STEEL

SYNTHESIS OF LIGHT HYDROCARBONS has played a major role in the work at Midwest Research Institute, where they are proving . . .

Research Is One of the Oil Industry's Greatest Allies

Oil men are pouring dollars into science in an effort to soften a tough competitive market. And it's working.

By **ANTHONY GIBBON,** WORLD OIL Staff

OIL MEN who seek products to expand their sales in a tough competitive market are turning more and more dollars to research. And they are finding that independent scientific inquiry can be one of their staunchest allies.

In the half-century since petroleum has been a top-ranking fuel in America, research has shown the product also has many supplementary sources. But the industry is only on the threshold. Every day, additional uses for various facets of petroleum are being uncovered both in the research laboratories of large oil companies and in independent research facilities.

A few of the new aspects of petroleum applications is indicated in a survey of the work being done at Midwest Research Institute in Kansas City, Missouri. An independent, non-profit facility, Midwest Research, situated at the edge of one of America's richest oil areas, has played an important role in petroleum research.

Midwest Research is less than a decade old, having been founded in 1944 when a group of Midwestern business and civic leaders and educators met to find a way to enhance the scientific and industrial progress of the region.

New laboratory. Since then, success of the Institute has been indicated in many exponents. Perhaps the principal one was the plan for a new $1.5 million building for the research facility. Construction on this new laboratory center in Kansas City began in 1953.

Efforts at Midwest are spearheaded by Dr. Charles N. Kimball, who has been its president since 1950. Dr. Kimball has a record of achievement as a practicing engineer, an administrator of scientific research programs, and business executive.

After receiving his doctor of sciences degree at Harvard, Dr. Kimball was associated with the Radio Corporation of America. During the war, he was a board member of the Aircraft Accessories Corporation and, later, as vice president of C. J. Patterson Company in Kansas City he brought the application of industrial

electronics to the baking, milling and food fields.

Prior to becoming president of Midwest in 1950, he was technical director of the research laboratories of Bendix Aviation Corporation in Detroit.

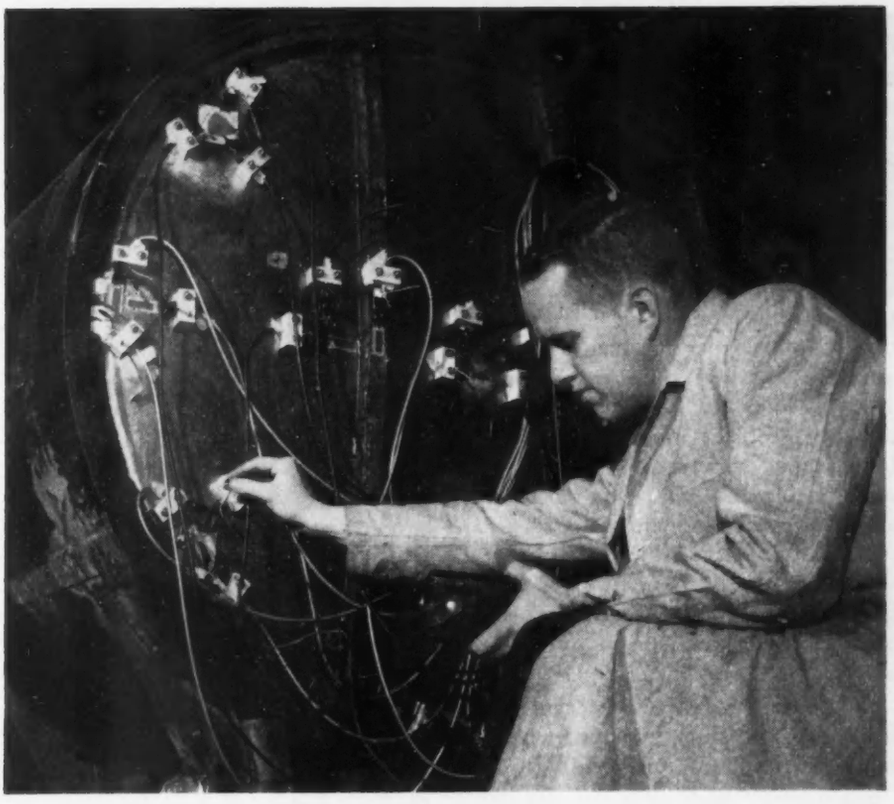
Throughout its brief history, Midwest Research has been intimately associated with the oil industry and has been supported by men vitally concerned with various facets of oil, gasoline and gas production. That these industrial executives have given succor to the new Institute, particularly in its fledgling days, is indicative of the value which oil men of the vast Middle West place on oil research.

Wide support. Names of a few of these oil industrialists indicate the support Midwest has received from the industry. Among them are Ben C. Adams, president, Gas Service Company; Colonel T. H. Barton, chairman of the board, Lion Oil Company; E. F. Bullard, president, Stanolind Oil & Gas Company; Parker B. Francis, president, Puritan Compressed Gas Corporation; S. B. Irelan, president, Cities Service Oil Company; R. R. Irwin, area manager, Refineries and Pipe Lines, Socony-Vacuum Oil Company; D. S. Kennedy, president, Oklahoma Gas & Electric Company; D. A. McGee, executive vice president, Kerr-McGee Oil Industries, Inc.; Harry Moreland, president, Great Lakes Pipe Line Company; Harold E. Purdy, manager, Standard Oil Company, Inc., J. G. Puterbaugh, president, McAlester Fuel Company.

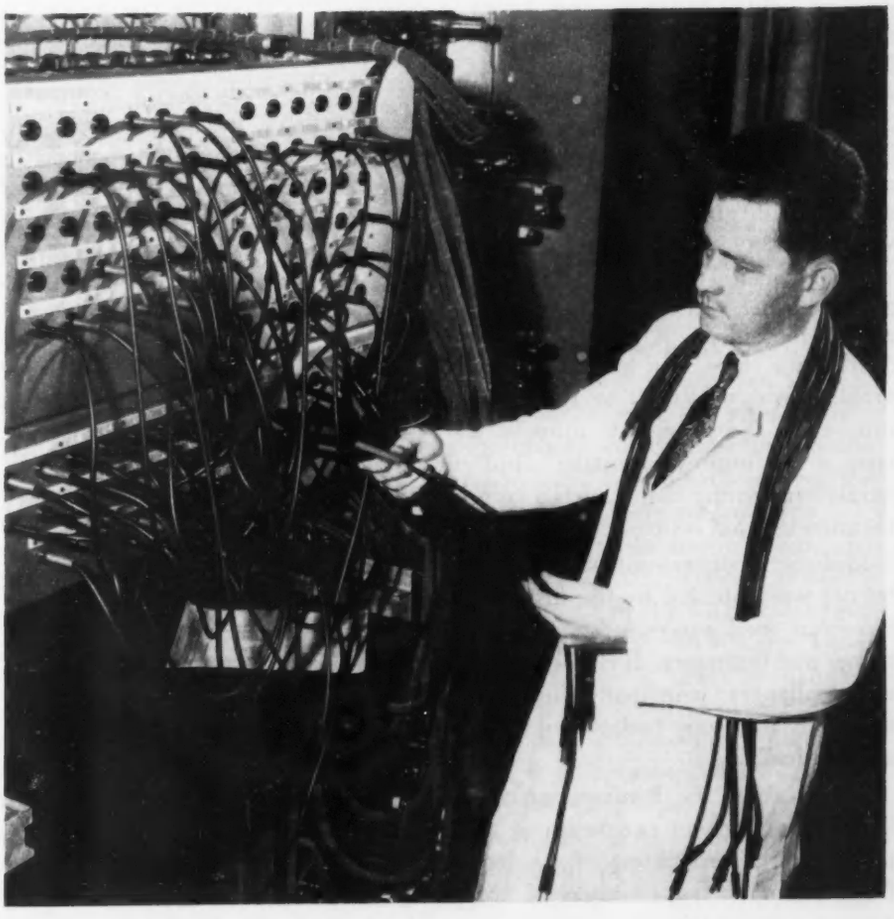
The Institute is well-equipped for petroleum research, and facilities will be substantially enhanced in the new building. The petroleum chemistry section is well along toward becoming one of the finest of independent research centers in the nation.

In the general and analytical laboratories and the petroleum chemistry section at Midwest, many teams of petro-chemists are at work on diverse projects.

Part of this work includes studies of chlorinated hydrocarbons, distillation and fractionation, studies on tray



A MIDWEST ENGINEER makes strain gage measurements on a petroleum trailer tank prior to design of a new type tank which resulted in a weight saving of approximately 1500 pounds.



PROBLEMS IN FLUID FLOW, head loss and other factors common in pipe line networks are measured by an electronic analyzer.

efficiencies, development of a pentane fuel system, thermal dehydrogenation of ethane to produce ethylene, studies of corrosion problems on secondary oil recovery, work with microcrystalline waxes, development of new products from asphalt, and various coating problems.

More on a mechanical or survey tangent are such Midwest Research tasks as development of a combination gas-oil burner for heating appliances, a McIlroy pipe line network analyzer for study of distribution and pressure problems in a pipe line system, refinery design problems, a survey and process evaluation of ammonia plants utilizing natural gas as a raw material, a study of product identification devices for pipe lines, and an investigation of the problems of barging petroleum on inland waterways.

These are just a few of the Midwest projects concerned with the oil industry problems and possibilities.

Research results. The work with microcrystalline waxes is a good indication of the prospects of research. These waxes are a petroleum by-product, obtained from the heavy ends or waste material of oil. It is from these waxes that such substances as floor and shoe polish, paper and metal coatings and waxes for butter, ice cream and milk containers are derived. At Midwest, chemists are seeking still greater uses for these versatile waxy substances.

Development of the combination gas-oil burner was a significant Midwest achievement. A project of gas distribution firm, the gas-oil burner problem was presented to the Institute after the company foresaw a chance to improve heating appliances through the use of such a combination ignition system.

Midwest engineers did the job. The burner was patented by the firm and has been used successfully in many homes and businesses. It enables heating appliances, principally furnaces, to switch from one fuel to the other automatically.

On occasion, the Institute initiates its own research in petroleum or oil projects. The production of ethylene from ethane is an example of this type of scientific inquiry. The Institute set up equipment to determine if such a process was feasible. It was discovered that ethylene, the ingredient used in preparing anti-freeze products and fuels, could be produced from ethane more economically than by other methods.

DURING A TESTING PHASE, a semi-automatic current extractor is used in extracting material from one solvent to another, the two solvents being immiscible.

A great variety of scientific equipment is available at the Institute for petroleum research. A complete petro-chemistry lab is installed, in addition to such important specialized devices as a Podbielniak-type column, used in analyses; a counter-current extractor for various studies of petroleum or derivatives; an electron microscope, and other instruments, including the pipe line network analyzer.

HEAD MAN. Dr. Charles N. Kimball (above), Institute president, has headed the organization since 1950.

The latter device is one of a very few in use in the nation. By use of various electronic components, representing various facets of a pipe line system, problems of distribution and pressure can be studied with ease on this instrument. It has been applied on gas and oil distribution perplexities for clients throughout the country.

But Midwest's success in oil research is not the result of its physical equipment. Much more than that, it is the result of highly skilled staff members with intimate knowledge of oil, gas and gasoline peculiarities and possibilities.

Key personnel. At the head of Midwest's chemical sciences division is Dr. M. H. Thornton, a chemist with extensive experience in many specialties. W. S. Gillam, manager of chemistry research, and W. W. Niven, Jr., manager of chemical engineering, also are tops in their fields, and are closely connected with oil research problems.

Staff chemists whose work with petroleum products has been important are Dr. Frank C. Fowler, Samuel M. Moffett, R. A. Carpenter, James G. Seay, and William E. Clark, all of whom have either worked for oil companies or who have extensive lab experience in petroleum studies.

Perhaps the most significant indication of the value of petroleum research at Midwest is the number of sponsors who have brought such tasks to the Institute. Included in the long list of such sponsors are the Bareco Oil Company, Battenfeld Grease & Oil Corporation, the Ethyl Corporation, Fractionation Research, Inc., the Gas Service Company, the Great Lakes Pipeline Company, Kerr-McGee Oil Industries, Inc., Puritan Compressed Gas Corporation, and others. And other firms, not directly connected with gas, oil or gasoline have sponsored petroleum research tasks.

These sponsors have found that research in petroleum and its byproducts can pay off with handsome dividends. They have found it a fact that research is one of petroleum's most valuable allies. —**The End**

AFL-CIO Merger Could Boost Fortunes of Oil Union Head

Meany and Reuther trying hard for unification this year or next. Major barrier removed.

IF THE 15 MILLION-MAN AFL-CIO merger goes through, O. A. (Jack) Knight's CIO Oil Workers International could become very powerful and Knight, himself, could become a labor leader of no mean stature. This assumes that some day all AFL-CIO oil, chemical and related unions would be unified, with Knight the top man. But there are many big "ifs" ahead, and the biggest in the currently reshaping trades union mosaic are whether the AFL and CIO will actually amalgamate and whether Knight would be a mutually-acceptable leader in so formidable a combine.

George Meany and Walter Reuther AFL and CIO presidents, respectively, are trying hard for unification, either this year or next. Progress is being made. Traditional rivalries, such as national political allegiance and crafts versus industrial unionism, are being minimized.

The toughest remaining problem, according to AFL-CIO circles, is how much of his own autonomy Reuther would be required to surrender and whether this, in turn, would stir up rebellion in his 30-odd unions. The unions—and Reuther—want in any merger an industrial union department in which no CIO affiliate would forfeit its identity. Merger maneuvers in the past 18 years collapsed over this issue. But both Meany and Reuther now think it can be bridged.

Meany said in a year-end statement that "prospects toward labor unity in 1955 are brighter than ever before . . . on a completely fair basis that will protect the rights and integrity of all affiliated unions."

Reuther spoke in similar vein, making it possible the organizations will take the final step at their conventions next fall.

The unification committees held their most recent meeting in Washington January 4. Meany and Reuther, both appearing optimistic, instructed them to prepare specific recommendations on merger problems to be submitted at another meeting in Miami Beach, Fla., February 8.

Knight is plumping for unification. Having failed to weld American and Canadian oil and chemical workers into a million-man coalition under his so-called Philadelphia Plan, he envisions the AFL-CIO combine as an opportunity to realize his ambition. The merger would bring under one banner Knight's 90,000-man union, the 91,000-man AFL International Chemical Workers, and the 80,000-man CIO United Gas, Coke and Chemical Workers. Knight has a Feb. 25 merger date with the latter at Cleveland.

In the future labor setup, the coalescence of these three unions would try to capture 800,000 workers in about 20 independent oil and chemical outfits which rejected Knight's Philadelphia Plan. None of these was willing to surrender its autonomy, and all looked askance at Knight's bold plan to create a master union that could fasten a strangle-hold on the oil and chemical industries.

As of now there are no advance guarantees of Knight's role after an AFL-CIO consolidation. Reuther will have to wrestle with that in his current negotiations. Nor is there any assurance—if he is kept around—that Knight could take over the AFL chemical workers even though his OWIU and the UGCCW merge. Chemical workers are no longer a nonentity in labor's ranks. They are multiplying by unorganized thousands and are looked upon hungrily by labor leaders. Knight recognized this when he set out to absorb the UGCCW which, oddly, includes comparatively few petrochemical workers. Knight doesn't know whether he could move in on the AFL union, but he does see the AFL-CIO combine as the wedge into an expanding field which, joined with petroleum, holds forth a luscious plum.

The merged organizations would have tremendous economic strength and unlimited potentialities. They could use the millions now spent on rival membership campaigns to organize the unorganized. High on the list would be company-dominated oil and chemical groups or those without any type of affiliation. There no longer would be costly disputes, such as the AFL-CIO no-raiding pact was intended to end.

Those are only facets of a developing pattern that may lead to labor unity unrivalled in world history and create a political force unlike any the major parties have ever reckoned with.

Meanwhile, and after much delay, the OWIU-UGCCW merger may go through. The two unions will meet separately at Cleveland and then are scheduled to convene jointly. Still standing is an offer by President Dave McDonald of the CIO steel workers to take over the UGCCW and hand it a lush organization fund.

The UGCCW has locals in petrochemicals, soaps, drugs, cosmetics, coke, creosote, tar, glass, gas, brick, and even in some meat plants. Some of its officers loudly resisted the merger but capitulated when assured the combine would make for a strong organization. Like the oil workers, the UGCCW has suffered from size.

Reuther was the strong arm behind the move. He threatened financial abandonment of the Chemical Union unless it threw in with Knight. There is no guesswork about Reuther's objective. In his unity talks with Meany he will have another big union to use as a bargaining point. In other words, Reuther is not going to "beg" his way into the AFL. He wants to be on about an even footing in the dickering. Current membership of the AFL is 10 million as against 5 million for the CIO. —**The End**

You Can Stop Pilferage

Are you encouraging employes to think of you as a soft touch? Here is a tactful approach to a widespread problem.

By AUREN URIS,
Research Institute of America, New York City

IN ANY ASSESSMENT of the pilferage situation in your company, a necessary preliminary is to gain some specific ideas as to the reasons behind the activity. It is not enough, for example, to say that dollar greed motivates the pilferer. There are other motivations or conditions that may explain individual cases:

• Management carelessness. Supervisory negligence in the treatment of company property quickly conveys to the rank-and-file the idea of easy pickings. The thought comes logically: "If the supervisor doesn't care, why should I."

• Employe resentment. Thefts prompted by this motive often baffle authorities because of the apparent illogicality. The items stolen frequently are of no conceivable use to the thief and have little dollar value. Behind such depredations you'll generally find an effort to "get even with the company" for some reason or other.

• The recalcitrant individual. In about 10 percent of the cases, culprits are actually near the neurotic or even the psychopathic level. Their motivations have no relationship at all to management practices.

In planning countermeasures, keep in mind that there are two distinct but related problems you've got to lick. First, you have the practical aspects to consider, the procedural moves you can take to minimize losses. Second, you have the psychological aspects, represented by employe attitudes.

Here's an approach that's suggestive rather than exhaustive. Nevertheless the steps described should form the core of any anti-pilfering action you may contemplate:

I. Solving the "Attitude" Problem

Analysis of current remedies leads one to conclude that the best solution in all cases is *not to lay down the law —at first.* A step-wise approach seems to be more likely to stop the stealing, and do it in a way that creates the minimum resentment all around. Here's an approach that moves forward with full awareness of the attitude problem:

1. The first step is confined wholly to the supervisory and employe level. The supervisor calls the group together. The sole purpose of the discussion is to acquaint people with the problem, to show them the extent to which it is happening, the total cost involved, and the fact that it is THEIR problem. He then asks what "we" can do to control the thievery?

2. If stealing continues, the supervisor takes a firmer stand in a second meeting: "Well, it seems that our first discussion wasn't enough. We're going to have to take corrective measures. Which ones will be most effective in your opinion? I'm willing to pass along your suggestions."

This time a definite commitment should be obtained from the group to enforce their proposals. Giving them a final vote has been found effective.

3. If the situation has not been substantially corrected, the way has been prepared for drastic top-management action: "We're sorry, men. We've tried everything we know to help YOU take care of this situation. Now, in YOUR interests as well as our own, it's necessary that these procedures be instituted." Then spell out the action you will take. This might include:

- . . . setting up a checkout system for equipment if you don't have one;
- . . . charging the user for each small tool or other item not returned;
- . . . proceeding with whatever investigation is necessary in order to get back expensive items that are missing.

Those who have used this "creeping barrage" attack on the problem favor it for two reasons:

• Employes have been given every chance to eliminate the pilfering on their own—thereby saving face and even strengthening team spirit.

• If you finally do have to take action, people are much less likely to feel that a "high-handed" approach is being used on them.

II. Solving the "Procedural" Problem

It pays to look into the physical conditions from which the problem stems. What makes a thief may be difficult to pin down. But you do hit pay dirt when you take into account the facts of temptation.

It's much easier to eliminate temptation than to catch a thief. Consider:

• Encouraging management personnel to set up reasonable physical barriers—locks on bins, tool cabinets, etc.

Rigid controls over possession and use of keys are essential. Too often keys hang in the freight elevator, or near doors, for example, where anyone can use them or make duplicates.

No employes other than stock personnel should have physical access to inventories of valuable items.

Surprise spot-checks of inventory at irregular intervals are also good practice, and should certainly be made frequently for expensive goods. But be sure to have stock counted by persons other than stock room employes.

• Delegating some responsible person to keep an eye on things "in general" during periods others are out.

If overtime is necessary, have a responsible official on hand to prevent theft and alterations of records. Where an individual puts in unusual overtime, it might be a good idea to check the situation, particularly if the employe persists in working alone before or after regular hours.

• Check your scrap and junk disposal. Scrap has a high value today and companies which haven't tightened controls over disposal, take a risk.

A truck driver for a large company regularly delivered loads of scrap to a local dealer. An anonymous telephone tip reported collusion between the driver and dealer on false weight certifications. Thefts over a three-year period were estimated at $25,000.

Ancient wisdom—Statistics show that ease of access makes a whale of a difference. Few people will open a purse and steal; more people will be prompted to take money lying in plain sight. It's the same principle that you run into in connection with mail. Hardly anybody will open a file to read another person's correspondence—but your eyes can't stay away from the letter lying on a desk.

Ancient Roman law recognized the facts. Lighter penalties were imposed for the theft of articles left in the open. People haven't changed since then: more items vanish from open shelves than from locked cabinets.

—The End

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Depletion Allowance Talk Enters Imports Dispute

Secretary of the Treasury George M. Humphrey has no plans to recommend cuts in the percentage depletion tax allowance this year, but his experts are keeping it "under continuing study."

There are fairly sound reports in Washington that the administration is being deliberately vague about depletion until impending fights over imports are more clearly delineated. The imports problem is currently being studied by the President's Cabinet Committee on Fuels Resources. In this connection, President Eisenhower's advisors are reported to have warned the importing companies to hold 1955 imports to the 1954 level, lest the Administration be forced to take a hand. Some oil and gas circles in the Capital saw this as a tacit threat that if the importers do not police themselves, the Administration may float talk about possible cuts in the 27½ percent depletion allowance.

Meanwhile, however, committee shifts in the new Democratic-controlled 84th Congress augur strongly against any tampering with the depletion allowance. Senate Democratic Leader Lyndon B. Johnson shifted from the potent Senate Commerce Committee to the tax-writing Senate Finance Committee which already is friendly to oil and gas. Johnson's move ousted Sen. Paul A. Douglas (D-Ill.) from the committee. Douglas is one of a small but influential bi-partisan Senate group which in years past has tried without success to cut the depletion allowance to 15 percent.

Of the 15 members now on the Finance Committee, nine are regarded as friends of oil and gas. Along with Johnson, they include Robert S. Kerr (D-Okla.), J. Allen Frear (D-Del.), Russell B. Long (D-Ia.), George A. Smathers (D-Fla.), Eugene D. Millikin (R-Colo.), Edward Martin (R-Pa.), George W. Malone (R-Nev.) and Frank Carlson (R-Kan.). This substantial majority can keep any undesirable tax bill bottled up. Thus, any moves to reduce the depletion allowance seem foredoomed even if the House passes such a measure. But there also is pro-oil strength on the House Ways and Means Committee where all tax legislation must originate.

A new addition to this committee is Rep. Frank Ikard of Texas. Ikard already has made it plain he will fight any attack on depletion. Supporting him will be congressmen from Arkansas, California, Louisiana and Pennsylvania. Ways and Means is now headed by Rep. Jere Cooper (D-Tenn.) who has shown no disposition in the past to alter depletion.

At his press conference, which preceded release of the President's fiscal 1956 budget, Secretary Humphrey was both forthright and vague in discussing depletion. Asked point blank why he has depletion under continuing study, he replied:

"Well, I will be frank about it. I think that is one of the most difficult things that anybody has to consider. It involves a great many things, a great many problems to think about. Our whole economy is based upon cheap power. Cheap power comes from fuel and our fuel problem is one of the great problems of this country—as to how to handle our fuel and TO MAINTAIN AN ADEQUATE RESERVE OF FUEL. Where is it going to come from? What kind of mobilization base should we have? So the stimulation for the development and maintenance of proper reserves of oil and gas, as well as other things, is one of the big problems that we have to balance out—as to what is the right thing and how to do it."

Asked if he could cite any specific loopholes in the new tax law enacted last year, he responded: "We haven't found any yet that we think need legislative action." Pressed for further explanation, he said: "There are a number of things the boys are studying but we have nothing we now contemplate action on."

President Eisenhower said last year that percentage tax depletion would be studied for possible future action. Humphrey's remarks must be interpreted in that light. But he told questioners that, as of now, "we will not have any proposals which may involve a major revenue pick up." He added, however, that "I don't want to rule out anything. I don't want to prejudge what we are trying to decide. I am not going to guess ahead."

FPC Official Doubts 'Waste' Bill to Pass

The confusion compounded upon confusion which has marked FPC efforts to regulate gas sales may seem crystal clear by comparison with a new snarl threatened last month.

Into the Texas legislative hopper went a bill which would require the Texas Railroad Commission to set minimum gas prices to prevent "economic waste."

Introduced for the admitted purpose of nullifying in Texas the regulation of wellhead prices by FPC, the bill challenges the federal agency to a court hassle.

When asked for an opinion on the Texas measure, Commissioner Seaborn L. Digby of the FPC declared: "Unless this bill was purely a conservation measure I believe the FPC would not feel bound by the state law. There has, however, never been a test case of this type even though Kansas and Oklahoma have minimum price laws. I doubt the Texas Legislature will pass the law. It has rejected such in the past except where they are strictly conservation measures. Texas has always resisted price fixing by the legislature. There will be no FPC policy determination until any direct conflict is adjudicated for decision."

Willard W. Gatchell, general counsel for FPC, had this to say: "We generally approve conservation measures, but questions of pricing conflict have to be settled as they arise. If the Railroad Commission used a fair field price rule, I doubt there would be any conflict."

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Stage Cementing

the BAKER WAY

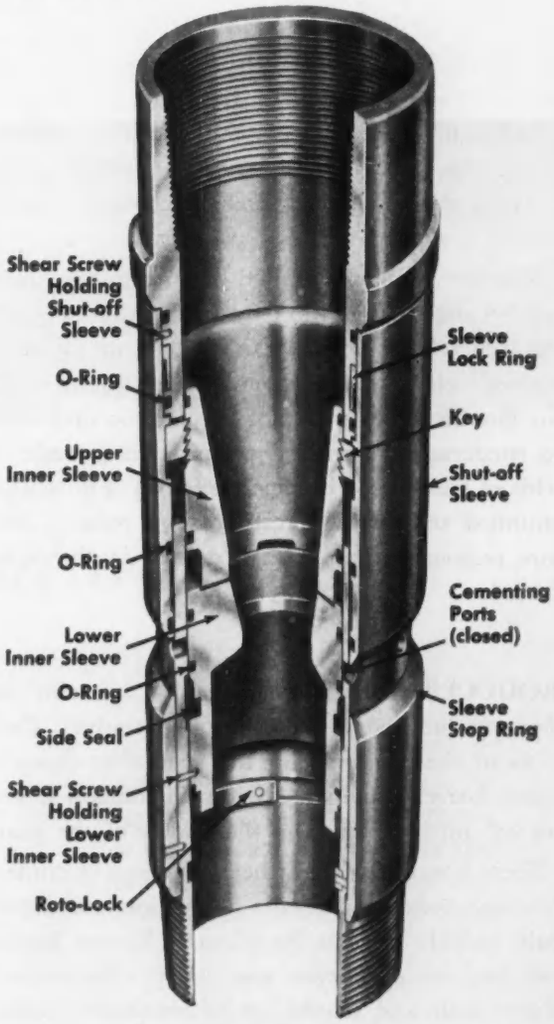
Fast, simple, positive two-stage cement jobs are accomplished in a routine manner with the Baker Model "F" Stage Cementing Collar (Product No. 200-F) in combination with other Baker Equipment. In addition to positive, mechanical closing of the cementing ports upon completion of the second stage, you are assured of these outstanding advantages . . .

1. The cementing ports of the Stage Cementing Collar may be opened at any time after completion of the first stage, and fluid may be circulated through the stage collar for any desired length of time before starting the second-stage cementing.

2. A positive, leak-proof seal of the cementing ports is ensured after completion of the final cementing stage. The cementing ports are sealed off from the OUTSIDE of the Stage Collar by an *outside* sleeve with oil-resistant synthetic rubber seals. After this outside sleeve has been closed, it is locked in position by the "Sleeve Lock Ring" and it cannot thereafter be moved by the passage of tools through the collar, even during the drilling-out operation.

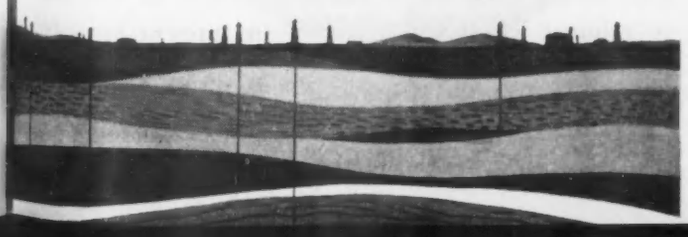
3. Operation of the stage collar is effected by fluid pressure applications only, and no movement of the casing is required after the first-stage cementation has been completed. Baker Stage Collars operate perfectly in either deep or shallow wells, even under difficult well conditions.

4. All internal parts of the Baker Stage Cementing Collar—including the Trip Plug and the Shut-off Plug—are constructed of readily drillable magnesium and/or rubber. When the internal mechanism of the Collar is drilled-out, the operator is left with a FULL CASING BORE free from "tool-catching" and "rubber-slashing" shoulders or projections.



Baker Stage Cementing Collar (Product No. 200-F)

Any Baker representative will appreciate the opportunity to discuss with you the use of Baker Stage Cementing Equipment in your wells.



BAKER OIL TOOLS, INC., HOUSTON · LOS ANGELES · NEW YORK

By **RAY L. DUDLEY,** Publisher, and **WARREN L. BAKER,** Editor

Excessive Stocks Can Be Avoided

GREAT PROGRESS in the elimination of excessive gasoline stocks has put the petroleum industry of the United States in its best economic position in more than a year. This gives the industry an excellent opportunity to avoid surplus motor fuel inventories which have plagued it during the past two years.

Whether or not the desired balance in gasoline supply and demand continues to exist next spring depends upon how well refiners are able and willing to adjust refinery product yields to requirements during the next three or four months. They must not become too optimistic over the encouraging turn and permit either crude runs or yields of gasoline to become excessive. This will require continued self-imposed restraints by refiners, but of a more reasonable nature than existed in the latter part of 1954.

•

PRODUCERS ALSO must exercise restraint and not allow production to become too excessive. Crude oil stocks at the beginning of the year were down to 261 million barrels, compared with 276 million a year ago and 285 million barrels in the middle of the year.

There is no need for further reductions in crude stocks. However, excessive domestic production and import rates could quickly change the picture. Recent increases in both domestic production and import volumes are of too large a scale and should not be continued indefinitely.

U. S. crude production during early January was averaging 6⅔ million barrels daily, the highest volume in history, and half a million barrels above the daily average during last August, September and October. Meanwhile imports have averaged over 1¼ million barrels daily during recent weeks. This, too, is a record quantity.

Such high supply rates can quickly change the industry's favorable crude oil picture. Some increase in crude stocks would not be harmful, but producers and importers must avoid creating excessive inventories. Both production and imports during spring months will need to be reduced from their current record levels. The longer high import and producing rates are permitted to continue at present peak volumes, the more drastic will be the reduction necessary.

The best course of action would be to reduce them in the immediate future and avoid creating excessive conditions which would require very drastic reductions later.

•

IF REASONABLE RESTRAINT is exercised by refiners, producers and importers, the economic position of the industry during 1955 can be much better than during the past couple of years. No unreasonable reductions in either refiner runs and yields, production or imports will be necessary to maintain a good balance, now that the excessive quantity in gasoline stocks has been absorbed.

Motor fuel stocks have shown remarkable improvement. In mid-January, 1955, they totaled 162 million barrels, 1⅓ million barrels less than a year ago. Only two months ago they had been 5 million barrels larger than at the corresponding period of the previous year, while three months ago they were 10⅓ million barrels higher, and last June had been 22 million barrels greater than 1953 volumes.

Such vast improvement constitutes a real achievement. It has been attained despite gasoline demand being only slightly higher than a year ago. Reduced crude runs to refinery stills and adjustment of product yields to reduce the volume of gasoline manufacture are responsible for the progress. The road ahead need not be as difficult for refiners. Runs and yields now need to be held only to volumes which will maintain the present favorable position.

Firemen don't all drive red wagons

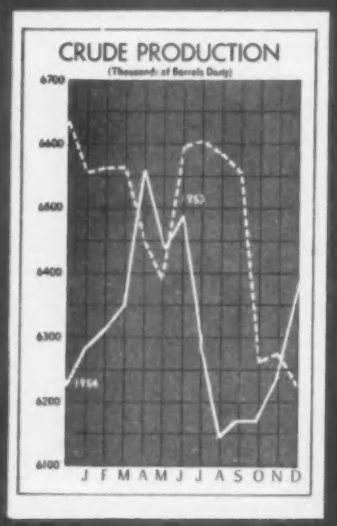
They say that it gets into a fireman's blood . . . the way they want to be on hand for every alarm. Truth is, they feel a strong devotion to their jobs and duties. They know somebody needs help fast . . . and it's their job to give it to them.

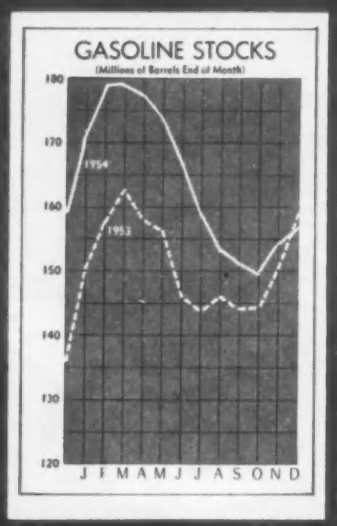
Every industry and every business has its "firemen," too. In the oil industry, your supply store personnel fit this picture and feel this responsibility to you . . . the oil operators who work around the clock. As a result, they are ready day or night . . . rain or shine . . . to get to your location as quickly as possible with anything you need to keep your operations running smoothly and safely. Make it a habit to call on your supply store first.

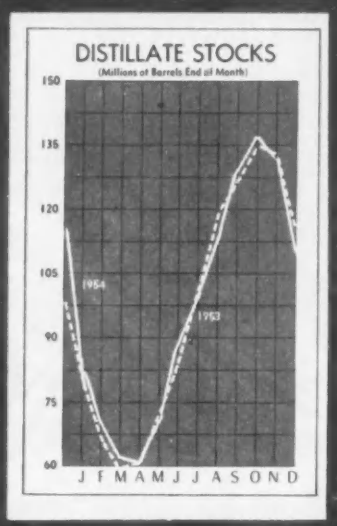
In this 50th year of service to the oil industry, Larkin is proud to have the opportunity to salute and say thanks to the thousands of supply store men who have helped us along the way. Without your assistance, our job would have been a lot harder.

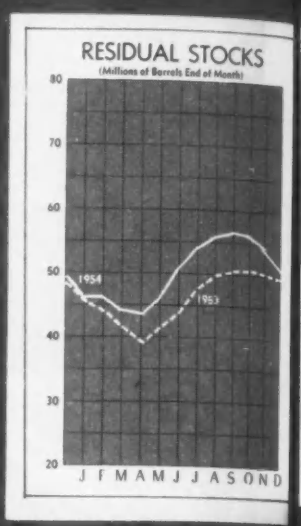
LARKIN
...Through Your Supply Store

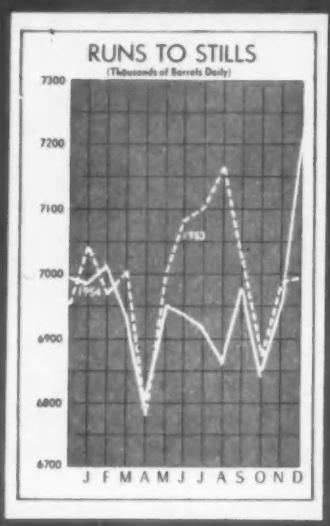
LARKIN PACKER COMPANY, INC. • ST. LOUIS, MO.

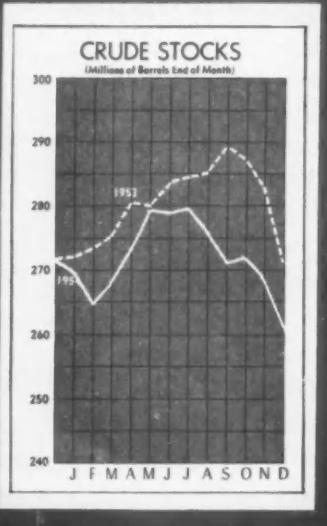












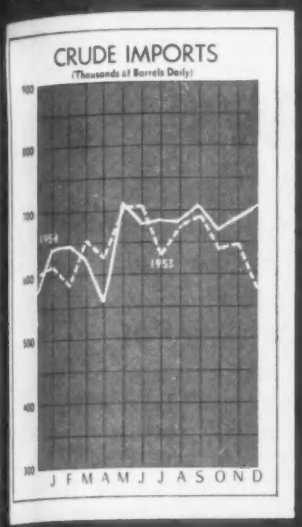
Petroleum Trends in U. S. . . .

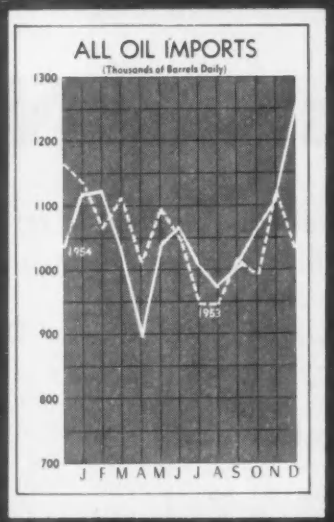
By CECIL W. SMITH, WORLD OIL Staff

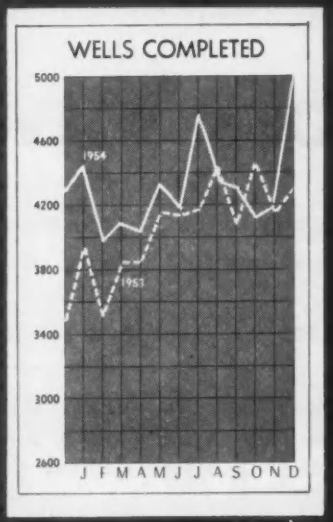
U. S. Crude Production by States

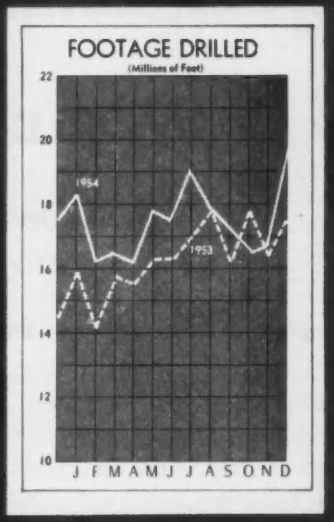
(Thousands of Barrels)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION Dec., 1954	Nov., 1954	Dec., 1953	% Diff. Dec. '53-'54	TOTAL PRODUCTION First Twelve Months 1954	1953	% Diff. '54-'53
Alabama	3.9	4.0	4.3	— 9.3	1,573	1,694	— 7.2
Arkansas	72.3	72.2	79.0	— 8.5	28,823	29,681	— 2.9
California	967.4	961.2	1,000.5	— 3.3	356,120	364,933	— 2.4
Colorado	140.5	141.0	93.2	+ 50.8	42,136	32,331	+ 30.3
Florida	1.4	1.4	1.4	.....	550	537	+ 2.4
Illinois	194.9	188.1	170.0	+ 14.6	66,469	58,886	+ 12.9
Indiana	29.0	29.1	33.0	— 12.1	11,109	13,013	— 14.6
Kansas	319.7	320.2	302.0	+ 5.9	118,843	115,259	+ 3.1
Kentucky	39.2	38.4	34.1	+ 14.9	13,755	11,618	+ 18.4
Louisiana	645.3	633.6	693.1	— 6.9	245,125	255,692	— 4.1
North Louisiana	104.1	104.6	115.5	— 9.9	40,557	41,702	— 2.8
South Louisiana	541.2	529.0	577.6	— 6.3	204,568	213,990	— 4.4
Michigan	32.0	32.5	33.9	— 5.6	12,001	12,284	— 2.3
Mississippi	93.3	92.8	94.8	— 1.6	33,607	35,425	— 5.1
Missouri	0.1	0.1	0.1	.....	69	26	+165.4
Montana	37.9	38.9	33.7	+ 12.5	13,464	11,630	+ 15.8
Nebraska	22.5	20.1	19.5	+ 15.4	7,380	6,257	+ 17.9
New Mexico	212.2	208.8	196.3	+ 8.1	74,773	70,394	+ 6.2
Southeast New Mexico	210.9	207.5	193.9	+ 8.8	74,071	69,639	+ 6.4
Northwest New Mexico	1.3	1.3	.....	.....	702	755	— 7.0
New York	11.2	11.1	10.2	+ 9.8	3,408	3,800	— 10.3
Nevada	0.2	0.2	.....	.....	35	.....	.....
North Dakota	24.3	19.4	14.4	+ 68.8	5,858	5,183	+ 13.0
Ohio	10.9	10.9	10.8	+ 0.9	3,825	3,550	+ 7.7
Oklahoma	496.9	494.6	523.8	— 5.1	186,423	202,570	— 8.0
Pennsylvania	19.8	19.8	27.7	— 28.5	8,934	10,669	— 16.3
South Dakota	0.1	0.2	.....	.....	35	.....	.....
Tennessee	0.1	0.1	0.1	.....	15	13	+ 15.4
Texas	2,702.9	2,648.7	2,610.5	+ 3.5	979,749	1,024,780	— 4.4
Dist. 1—South Central	46.3	43.7	39.0	+ 18.7	15,527	13,779	+ 12.7
Dist. 2—Middle Gulf	145.1	141.2	141.0	+ 2.9	52,155	56,792	— 8.2
Dist. 3—Upper Gulf	438.9	430.7	436.9	+ 0.5	160,003	171,238	— 6.6
Dist. 4—Lower Gulf-S.W.	239.6	233.8	245.4	— 2.4	88,617	94,974	— 6.7
Dist. 5—East Central	43.4	43.4	44.9	— 3.4	16,133	17,774	— 9.2
Dist. 6—Northeast	334.7	325.2	350.2	— 4.4	123,812	137,219	— 9.8
Dist. 7-B—North Central	129.5	129.2	120.5	+ 7.5	46,561	41,584	+ 2.0
Dist. 7-C—West Central	179.3	176.6	160.2	+ 11.9	65,656	60,422	+ 8.7
Dist. 8—West	869.4	850.4	810.7	+ 7.2	311,196	326,685	— 4.8
Dist. 9—North	192.5	190.2	182.9	+ 5.2	68,420	66,637	+ 2.7
Dist. 10—Panhandle	84.1	84.2	77.5	+ 8.5	30,300	27,571	+ 9.9
Utah	5.3	5.2	4.6	+ 15.2	1,887	1,807	+ 4.4
Virginia	0.1	0.1	0.1	.....	14	10	+ 40.0
West Virginia	7.1	7.4	9.4	— 24.5	2,894	3,038	— 4.7
Wyoming	267.0	246.1	237.5	+ 12.4	93,338	84,918	+ 9.9
Total United States	6,357.4	6,246.2	6,238.0	+ 1.9	2,312,212	2,359,998	— 2.0









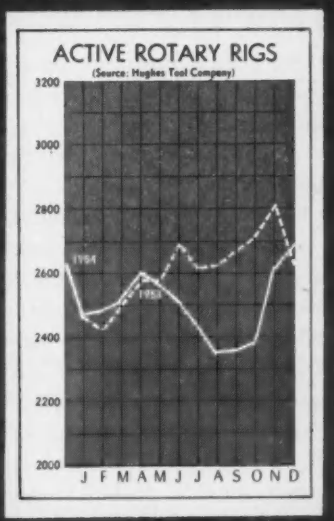
- Wells completed hit new peak
- Refinery runs at all-time high
- Oil imports also hit new level

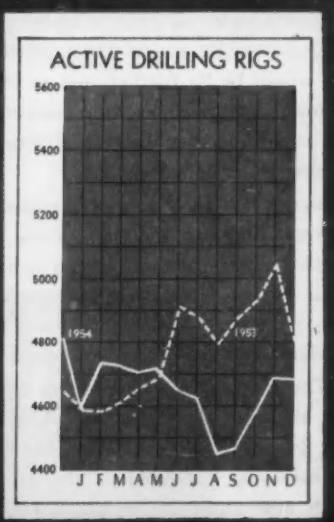
Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1952:											
September	6,518	7,017	264,723	3,428	120,991	1,502	117,252	1,230	56,200	615	932
October	6,518	6,883	269,776	3,301	120,062	1,458	120,721	1,203	53,052	643	1,037
November	6,487	7,049	267,852	3,416	129,509	1,510	116,096	1,299	53,069	624	984
December	6,634	6,952	271,928	3,361	136,028	1,509	99,582	1,302	48,706	603	1,165
1953:											
January	6,555	7,042	272,250	3,384	150,518	1,528	80,655	1,307	45,910	616	1,135
February	6,562	6,969	273,589	3,379	157,873	1,505	67,167	1,275	44,178	586	1,066
March	6,531	7,002	275,665	3,319	162,731	1,489	59,802	1,256	41,600	655	1,112
April	6,446	6,781	280,487	3,282	158,032	1,424	61,349	1,219	39,572	628	1,010
May	6,390	7,002	280,308	3,459	156,415	1,400	73,706	1,197	41,795	703	1,096
June	6,595	7,081	283,715	3,467	146,196	1,462	84,504	1,238	43,801	707	1,050
July	6,903	7,103	284,976	3,583	143,916	1,441	102,394	1,224	47,966	629	946
August	6,583	7,163	285,352	3,592	146,050	1,437	119,542	1,222	50,007	672	946
September	6,557	7,023	289,614	3,521	144,184	1,448	126,709	1,203	50,516	692	1,013
October	6,262	6,872	287,541	3,437	144,495	1,462	135,409	1,184	50,820	639	990
November	6,277	6,987	283,021	3,528	150,747	1,463	133,381	1,223	51,267	648	1,120
December	6,238	6,964	276,676	3,628	159,949	1,441	111,944	1,247	49,370	598	1,121
1954:											
January	6,240	6,947	270,811	3,431	171,704	1,550	81,044	1,271	47,474	617	1,143
February	6,379	7,068	266,918	3,476	179,950	1,545	70,390	1,241	47,119	621	1,144
March	6,507	6,923	271,867	3,375	181,297	1,458	60,270	1,168	44,249	654	1,088
April	6,615	6,811	280,310	3,404	177,006	1,374	61,721	1,140	44,362	574	950
May	6,471	7,038	282,250	3,482	177,606	1,372	73,581	1,148	47,009	708	1,021
June	6,500	6,947	285,155	3,483	165,404	1,399	86,325	1,123	50,216	624	999
July	6,242	6,916	284,894	3,480	158,010	1,416	101,657	1,089	54,365	724	1,038
August	6,168	6,862	281,043	3,492	153,168	1,453	117,579	1,069	56,332	664	966
September	6,151	6,939	274,608	3,511	150,916	1,514	128,061	1,086	56,702	672	999
October	6,135	6,834	269,442	3,457	149,661	1,545	139,128	1,066	56,541	642	1,065
November	6,246	6,955	267,642	3,408	150,441	1,573	132,925	1,115	54,851	684	1,107
December	6,357	7,203	261,486	3,536	157,228	1,651	109,631	1,138	51,361	701	1,240
Dec. 1954 Change:											
In Month	+111	+248	−6,156	+128	+6,787	+78	−23,294	+23	−3,490	+17	+133
In Year	+119	+239	−15,190	−92	−2,721	+210	−2,313	−2,385	+1,991	+103	+119
Week Ended:											
1-7-55	6,465	7,389	259,460	3,627	160,956	1,778	105,132	1,268	52,065	677	1,352
1-8-54	6,272	6,960	270,578	3,448	160,324	1,478	106,341	1,228	49,668	598	1,035

Source: Data for last two months from API; prior monthly data from Bureau of Mines.





WORLD OIL'S VIEWS OF THE NEWS

• Imports dispute rages . . . • Texas Railroad Commission refuses to cut allowables.
• Industry seeks public support in Phillips case . . . • Industry census under way.

Imports Argued at Capitol

The dispute over imports is hourly becoming more vitriolic at the Nation's Capitol.

• Eight bills to put imports on a quota basis have been introduced in the House.

• President Eisenhower, who opposes quotas, purposely omitted mention of oil in his reciprocal trade message.

• The National Coal Association wrote every member of Congress demanding remedial legislation.

• The Bureau of Mines entered the controversy with a warning that domestic crude production last year was down 2 percent and stocks were reduced by 14 million barrels.

• Russell B. Brown, general counsel of the Independent Petroleum Association of America, declared that for the four-week period ending January 7 imports averaged an all-time high of 1,308,900 barrels a day —15.2 percent of the total U. S. supply. Brown charged that "the importers have discredited business statesmanship." He said, in effect, that they had gone back on their implicit pledge to reduce imports through voluntary action.

Brown disclosed that representatives of state and local domestic producers would meet in Washington late in January "to evolve the domestic industry's basic pattern of activity in 1955 to restrict imports to a reasonable level." He said this meeting would be "a further step to effectuate action" authorized by the resolution adopted at a December meeting of independent producers at Fort Worth.

Brown also took note of President Eisenhower's omission but took some comfort in the chief executive's statement in his State of the Union message on conservation of natural resources. He said this may be significant in relation to imports.

The House Ways and Means Committee has already held hearings on bills to carry out Eisenhower's reciprocal trade request—a three-year extension of the present law with new authority to cut tariffs a total of 15 percent over the three-year span. It plans to take up the import problem separately later. Brown has requested permission for IPAA and other domestic producer organizations to testify. So has the National Coal Association. Soft coal production was down 14 percent last year, due mostly to residual fuel oil imports and natural gas competition.

The President's Cabinet Fuels Resources Committee will discuss the imports problem in its impending report, but there is some doubt it will make flat recommendations. Quota bills were introduced by Reps. Kelley (Penn.), Saylor (Penn.), Van Zandt (Penn.), Fenton (Penn.), Byrd (W.Va.), Kee (W.Va.), Siler (Ky.), and Morgan (Penn.). These are only forerunners. The NCA claims it has 130 House members and 22 senators lined up to support the measures.

While the outlook in Congress is doubtful, shifts of members on strategic committees have increased the likelihood of some action. Two Texans, Martin Dies and Walter Rogers, both Democrats, have been assigned to the House Commerce Committee which probably will consider quota legislation. Other members include Oren Harris (D-Ark.), William T. Granahan (D-Penn.), Kenneth A. Roberts, Harley O. Staggers (D-W.Va.), and John Bell Williams (D-Miss.).

The comparable Senate committee includes Sens. Price Daniel (D-Tex.), A. S. Mike Monroney (D-Okla.), George A. Smathers (D-Fla.), John W. Bricker (R-O.), Andrew F. Schoeppel (R-Kan.), John Marshall Butler (R-Md.), and James H. Duff (R-Penn.).

Imports Freeze Urged?

The White House disclaimed knowledge late last month of the source of a report by Drew Pearson, syndicated columnist, that the Administration will demand that Venezuelan imports be 'voluntarily' frozen at 1954 levels. Pearson said the solution was adopted by the Cabinet Fuels Committee after the committee suggested, over bitter State Department opposition, a freeze of all imports at 1954 levels. He said further that Deputy Defense Secretary Anderson persuaded the committee to take its decision.

Texas Oil Stands Pat

The imports dispute once again was reflected in the action of the Texas Railroad Commission last month when it refused to cut the state oil allowable. Firm in its oft-repeated view that reduction of Texas output allows imports and other states a more-than-fair share of the market, the agency set a February production of 3,241,438 barrels a day with fields on a 16-day flow.

This production schedule will be down 38,327 barrels a day from January allowable but as near it as possible for the short month of February.

Apparently certain of its ground, the commission acted at the close of an 11-minute public hearing. All purchasers except Shell Oil Company, Sun Oil Company and The Atlantic Refining Company suggested cutbacks.

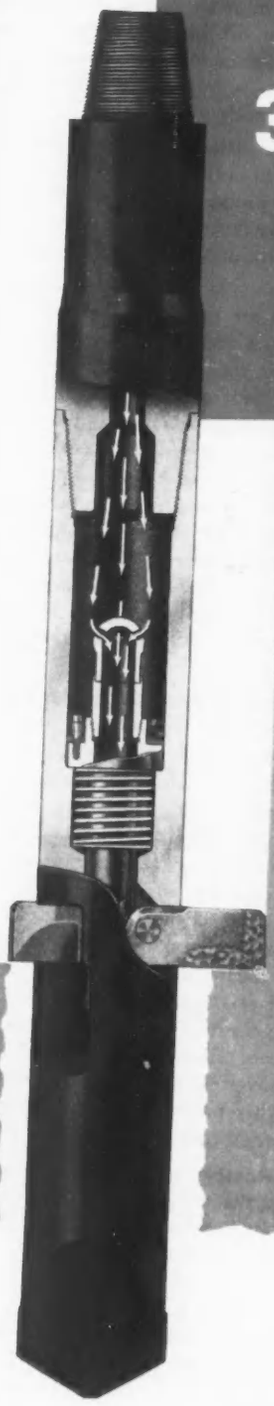
Thus, Texas allowable is the highest in history, except for November, 1952, when production was 150,000 barrels a day higher.

Meanwhile, Oklahoma is considering a law to raise that state's daily allowable to a minimum of 25 barrels per well. If passed by the legislature—and the measure is said to have the blessing of Governor Raymond Gary—the law would make it impossible to "circumvent" the minimum allowable by reducing the number of producing days per month or by any other means.

Until a few weeks ago, demand for Oklahoma oil was so weak that the State Conservation Commission was permitting minimum production of only 15 barrels a day per well. Shortly before his inauguration Jan. 10, Governor Gary supported pleas of independents before a Commission meeting that the allowable be raised to 20 barrels.

The state's conservation director said there was no market for the additional crude. But he was outvoted. The Commission ordered the 20-barrel minimum.

Recently, a group of Oklahoma independents organized the Oklahoma Independent Producers Association. Its aim is to recapture lost markets. Organizers point out that Oklahoma's crude output of about 500,000 barrels daily has remained at that level for 20 years. And, they say, other crude-producing states have increased their allowables considerably above figures of 20 years ago.



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FULL CIRCULATION to bottom (no internal by-pass) with this tool insures adequate fluid volume and pressure at the diamond point or bull-nose for fast removal of cuttings.

HYDRAULIC BLADE OPENING, accomplished by controlled pump pressure, expands blades uniformly through the opening cycle, allows automatic retraction on release. All blades work as a unit.

NON-CLOGGING BLADES and blade recesses require no circulation for cleaning, thus put pump volume where it's needed—*removing cuttings.*

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Public Told of Phillips Case

Not a single bill had been introduced in the new Congress late last month to overturn the Supreme Court mandate that the Federal Power Commission must regulate the price of natural gas sold in interstate commerce.

Numerous congressman were poised for such action but apparently were awaiting a go-ahead from strategists. They won't reveal plans, WORLD OIL was told, until blocs in both Senate and House feel they can win. At the moment they were awaiting public reaction to a publicity campaign to win consumer support for bills that would free gas producers from FPC control.

Ads appealing for consumer support are appearing in newspapers throughout gas served areas. Television and radio also will be resorted to. Spearheading the drive is the Natural Gas and Oil Resources Committee, industry group created last fall. One of the first ads to appear was paid for by the District of Columbia Natural Gas and Oil Resources Committee. Published in Washington newspapers, it defined the FPC regulations, told how they affect gas bills, warned of the consequences, and asked the readers to "reach your own conclusions, and make those conclusions known to your friends and neighbors." All, in turn, would write their congressmen.

Coincident with this, James R. Durfee, chairman of the Wisconsin Public Service Commission, charged Phillips Petroleum Company with waging a "gigantic propaganda campaign" to get Congress to bypass the Supreme Court's price-fixing decree. Phillips sells gas to the Michigan-Wisconsin Pipeline Company.

Reps. Frank Ikard (D-Tex.) and Oren Harris (D-Ark.) have served notice in floor speeches that they will offer bills to take the FPC out of the price-policing field. Harris is a member of the House Commerce Committee which will consider such measures. Two new democratic members of the committee are Martin Dies and Walter Rogers, both Texans and certain supporters of the Ikard-Harris bills. The new Senate Commerce Committee has several pro-industry members, including Price Daniel of Texas and A. S. (Mike) Monroney of Oklahoma. Senate Democratic Leader Lyndon B. Johnson of Texas, who was on this committee, shifted to the finance committee where he will be in a strategic position to thwart moves to cut the percentage depletion allowance.

didn't want the price-fixing
t place, was still trying to
at will meet complaints from
twice has changed the rules
to simplify its price-control requirements and is now weighing prospective changes based on hearings, Jan. 11-13, on principles and methods to be applied in fixing rates to be charged independent producers for gas sold in interstate commerce. Witnesses included producers, pipeliners, distributors, and local and state commissions.

There were many differences of opinion, some heated. The producers generally urged the commission to accept, as fair and reasonable, contracts made at arms-length bargaining.

Pipe line spokesmen were far apart. Some supported the producers. Others suggested modified field prices for future contracts. Others urged the commission to delay action until Congress has its say.

Distributors, for the most part, wanted modification of the fair field price for new contracts. They also would continue the FPC's June 7 price freeze on existing contracts unless producers could justify increases.

Spokesmen for the cities advocated use of the "original cost formula."

State commissions urged a sweeping FPC investigation of the whole matter. Wisconsin, however, urged the original cost formula. Nearly everybody except the producers was firmly against favored nation or escalation clauses.

FPC General Counsel Willard E. Gatchell, who has made conflicting statements on the commission's position on these clauses, was on hand to cite court cases bearing on FPC powers. In December he said unequivocally that after May 1, escalator and favored nation clauses would not be worth the paper they were written on—that the commission would NOT recognize them. A few weeks later he modified this. He said the commission retains "complete freedom" to decide its future position. He said that between now and May 1, when commission order 174-B takes effect, the FPC is free either to accept or reject the clauses even though they are expressly forbidden by 174-B after May 1.

Meantime, the commission has ordered 14 independent producers in the Clayton and La Gloria fields in Texas to show cause on Feb. 7 why they must not obtain FPC permission to terminate gas service, under an escape clause, to the Texas-Illinois Natural Gas Pipeline Company, Chicago. Gatchell says the commission does not recognize escape clauses under the Natural Gas Act. The producers were directed to show cause why they should not be classed as natural gas companies under the Act.

Ask Compensation Changes

Bills which would correct abuses in the Texas compensation laws and ultimately result in more reasonable insurance rates for the oil industry were introduced in both houses of the Legislature last month by Sen. Searcy Bracewell and Rep. Garth Bates, both of Houston.

Substantially the same provisions were made in both bills, according to an analysis of the proposed legislation made for WORLD OIL by Joseph M. Shelton of the Dallas law firm of Weatherred, Geary & Shelton.

With a single notable omission, the proposals are markedly similar to those which failed to come up for consideration and action in the 1953 legislative session despite the backing of approximately 100,000 Texas employers, including hundreds of producers and drilling contractors. Not included in the current bills is a proposal which would prevent appeal to the district courts from the findings of the Industrial Accident Board, except on points of law. This provision was strongly attacked as an attempt to abridge trial by jury and was a prime cause for failure of the 1953 proposals.

Most important stipulation in the new bills would overturn judicial decisions handed down in the Holmes and Glenn cases. The Holmes decision, applying to specific injuries, and the Glenn decision, make it possible for a highly paid worker to receive as much compensation for a 35 percent leg disability, for example, as for the loss of the entire leg. The legislation now proposed would calculate the benefits for partial disabilities based on the percentage of maximum benefits, rather than the wage rate. This would create a situation where like injuries would produce like recoveries and eliminate instances in which highly paid employes win maximum benefits for partial disabilities.

Another major provision aims at reducing the temptation for attorneys to appeal compensation cases for the greater fees to be gained in district courts. The new bills would make no change in the law allowing attorneys 15 percent of the first $1000 recovered and 10 percent thereafter for representing a claimant before the Industrial Accident Board. However, if the attorney elected to appeal to the district court, where he is now allowed 33⅓ percent of his client's award, he would be limited to 25 percent of the amount recovered or a total fee of $2000, depending on which is the lesser.

A third proviso would require that a compromise or settlement of a compensation claim must specify the weekly rate of benefits allowed and the number of weeks the settlement is intended to cover. One objective is to prevent an employe who has received a lump sum award for an in-

Too many soups spoil the cook

The independent business man has many problems to face each day, problems connected with each of the many phases of his business. The officers of The National Bank of Commerce are qualified by training and experience to assist you in finding a solution to many of these problems. This experience can be put to work for your company when you make The National Bank of Commerce your bank. Complete, modern banking facilities are available for all our industrial depositors.

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jury from returning to work, suffering another injury, and collecting a second benefit to sustain him for a period of time supposedly covered by the first award. The new bills would require that the time covered by a compensation be specified and that at no time would any person recover in any given week more than the maximum compensation allowed under law.

By specifying the time covered by an award, this proposal would also prevent the circumvention of the law which denies unemployment benefits to those drawing compensation. It is now possible for a claimant to settle for a lump sum and then receive unemployment benefits by making an affidavit that he is not receiving compensation payments at that particular time.

A fourth major clause would protect employers in cases where an employe aggravates an old injury. For example, if an employe is suffering from a 50 percent pre-existing disability and then aggravates that injury to an extent justifying an additional 20 percent disability, the present employer would not, as now, have to pay for the entire 70 percent disability. This clause is expected to make handicapped job seekers more acceptable to employers who now have cause to fear payment of total disability loss.

A fifth provision would revise the law on compensation claims arising from travel, which are particularly burdensome to the oil industry. The new bills propose that the test of a travel case must be the prime purpose for a trip. If, for example, an employe departing on a pleasure trip is requested by his employer to attend to some business detail while on the journey, the employe would not be entitled to compensation in case of an accident. But if the employe is on a business mission and the pleasure aspect is incidental to the trip, any injury would be compensable.

A sixth stipulation would bring about long-sought self insurance for financially responsible employers. If the bill becomes law, a company could become a self insuror if it has the free capital and surplus requirements of an insurance company and the same type investments. If such a company has a catastrophe hazard in the opinion of the insurance board, it would be required to make additional assurances by excess coverage of catastrophe insurance. As an alternative, a financially responsible employer would be permitted to qualify as a self-insuror by furnishing a fund or bond to guarantee compensation payments to his employes.

A final principal proviso would adjust maximum employe benefits upward to conform with present economic conditions. The present maximum allowance of $25 per week could be raised to $30 without further increases in insurance rates, the sponsors set forth.

Industry Census Under Way

Industry firms are receiving a government questionnaire aimed at securing data for the first nationwide business census in 15 years.

The census is covering 3,316,000 business firms, among them 35,000 in the mineral industries, primarily oil and gas.

There has been no census in the oil and mining industries since 1939. Business and manufacturers were brought up to date in 1947-48. In that 15-year span, the national economy has burgeoned so fast that past census figures are out of date.

Some of the questions to be asked are: Identification of your oil and gas operation, and nature of operations; company affiliations and ownership; employment and payrolls; man-hours of production, development and related workers, by type of work; cost of supplies, fuels, electric energy, contract work, and machinery; water use during 1954; horsepower rating of power equipment at end of the year; capital expenditures; cost of drilling; crude petroleum and natural gas extraction, and products and services.

The Bureau of Census of the Department of Commerce is conducting the census in cooperation with the Bureau of Mines so there will be no duplication. Product inquiries will vary by kind of industry, with the queries tailored to fit a specified industry or several closely related.

All recipients of questionnaires are being asked to mail their answers within 30 days. "A good job cannot be done without the cooperation of all businessmen who are called upon to report," the Census Bureau said. "The value of the censuses depends largely upon prompt and accurate reporting by business, and speedy compilation and publication of the results. Business men need facts in developing markets, determining production schedules, arranging distribution through efficient channels, and making the many management decisions that are required to meet the ever-changing industrial and consumer demand picture. Many a business man relies upon the industrial and trade census reports for reference data in preparing production and sales programs. Sales managers lay out their sales territories and sales campaigns and often fix sales quotas on the basis of census data. Market research organizations, trade associations, advertising agencies, and business advisory services depend chiefly on the censuses for their basic statistical information. Other non-governmental users include universities, farm organizations, labor unions, teachers, and so on. When business and industrial enterprises have to make decisions on today's and tomorrow's problems, they have to make use of various underlying facts—how large is the prospective market, how much competition will be met; will necessary materials and compounds be available; is there a good supply of workers, engineers, and salesmen. These censuses will provide the facts. There has been careful planning and preparation. Conferences were conducted between government agencies and business men representing trade associations and individual business concerns.

"Hundreds of associations and thousands of companies have cooperated in reviewing and clearing inquiries and lists of items such as more than 6000 sub-classes of products which will be included in the census of manufactures. Similarly, inquiries and items contained in the Business and Minerals industries were cleared through governmental and industry review."

The Bureau stressed that individual reports will be confidential. The data in them will merely be summarized to throw light on an industry or business as a whole. A host of businesses will not be covered by the censuses. These include transportation, communication, public utilities, real estate, finance, insurance, radio, television and law.

TET Airs Little Inch Plans

The Texas Eastern Transmission Corporation submitted to the Federal Power Commission a financing plan for proposed reconversion of a major portion of the Little Inch line from a natural gas to a petroleum products carrier.

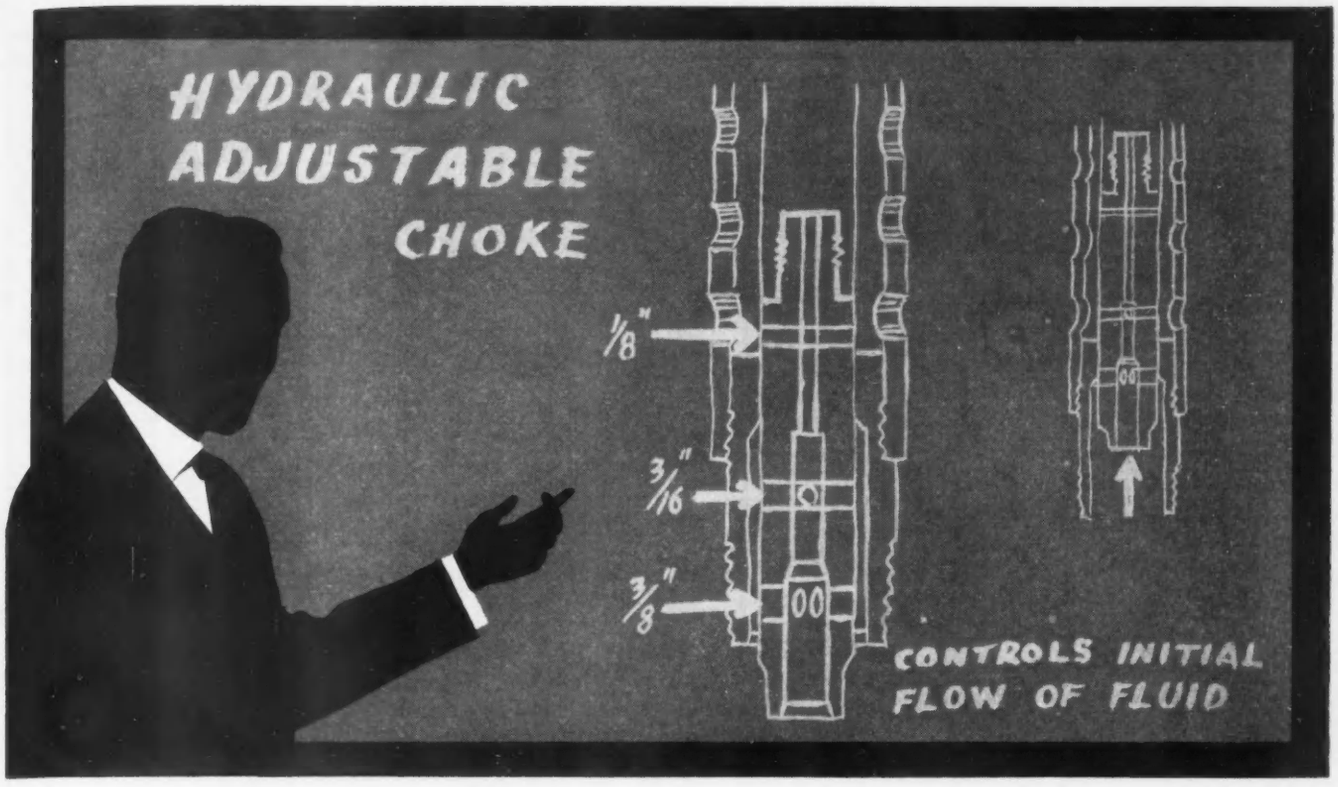
Under the plan, eight insurance companies agreed to purchase $40 million worth of new 3¾ percent first mortgage bonds which would finance part of the $85 million program now before the FPC for approval.

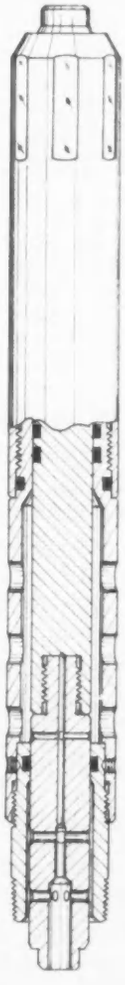
August Belmont, vice president of Dillon Reed and Company, Inc., New York investment bankers, testified the company would meet no difficulties in marketing junior securities to finance the entire program.

Egypt Will Seek Bids

Egypt soon will invite foreign exploration and development bids on about 240,000 square miles—162,000 square miles in the Western Desert, an extension of the Sahara Desert, and 78,000 square miles in the Eastern Desert, between the Nile River valley and Red Sea.

Also, Egypt has signed two new contracts for oil exploratory operations with West German firm Vereinigte Gewerkschaft Borgholzhausen—covering about 12,000 square miles in the Eastern Desert and northeast part of Sinai Peninsula—and National Petroleum Company of Egypt covering acreage in the same regions.





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It's the most dependable shock absorber... automatically adjusts to sudden pressure and flow of fluids when testing tool opens, provides a gradual release through choke openings of 1/8" to 3/16" to 3/8" to full.

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211 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG

U. S. Wells Completed in December and Total Year, 1954

STATE or DISTRICT	NEW WELLS COMPLETED AND FOOTAGE DRILLED															Rigs in Operation		
								TOTAL NEW WELLS			Total Footage December, 1954	DETAILS FOR YEAR						
												New Wells			Footage			
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Dec., 1954	Nov., 1954	Dec., 1953		1954	1953	Percent Diff.	1954	1953	31 Dec. 1954	30 Nov. 1954	31 Dec. 1953
Alabama				2				2	5	9	11,309	69	107	— 35.5	359,753	545,580	9	5	3
Arizona			1					1	1		6,339	10	6	+ 66.7	43,603	19,960	1	1	2
Arkansas	25		2	21				48	43	65	171,066	581	554	+ 4.9	2,049,830	2,079,777	33	34	39
California	154		5	53				212	226	209	920,661	2,433	2,575	— 5.5	11,065,195	11,349,317	245	250	279
Colorado	39		5	90				134	116	58	708,805	1,324	699	+ 89.4	7,255,077	3,639,412	82	78	68
Florida				3				3	1	2	17,935	31	33	— 6.1	195,566	205,666	4	2	4
Georgia												8	9	— 11.1	20,508	24,804			2
Idaho													4	—100.0		22,748	1	1	
Illinois	200		1	136				337	290	189	863,101	3,265	2,165	+ 50.8	7,984,248	5,430,731	306	325	245
Indiana	23		3	51				77	73	99	116,612	865	1,312	— 34.1	1,316,430	2,173,519	110	120	182
Iowa													1	—100.0		443			
Kansas	194		36	190			1	421	317	361	1,522,934	4,222	4,451	— 5.2	15,005,973	15,490,479	478	490	403
Kentucky	41		15	53	1			110	129	112	191,189	1,383	1,448	— 4.5	2,589,141	2,809,807	92	90	93
Louisiana	198	15	24	91				328	341	257	2,037,777	3,650	2,733	+ 33.6	22,651,830	18,646,075	294	314	252
North Louisiana	118	3	11	44				176	192	130	520,354	1,946	1,248	+ 55.9	5,778,702	4,365,997	55	58	54
South Louisiana	80	12	13	47				152	149	127	1,517,423	1,704	1,485	+ 14.7	16,873,128	14,280,078	239	256	198
Maryland													5	—100.0		19,715	3	3	1
Michigan	14		3	32				49	43	55	145,549	557	622	— 10.5	1,534,855	1,601,588	96	103	102
Mississippi	21			34				55	43	43	414,576	450	422	+ 6.6	3,203,617	2,897,226	42	47	29
Missouri												11	45	— 75.6	11,798	42,645	4	3	3
Montana	14		3	18				35	33	19	136,151	349	409	— 14.7	1,406,623	1,824,273	51	43	48
Nebraska	20		3	38				61	41	14	344,146	469	314	+ 49.4	2,624,696	1,619,722	34	37	18
Nevada				1				1			5,556	12	8	+ 50.0	61,712	11,842	6	4	4
New Mexico	52	1	36	13				102	81	102	511,091	1,168	1,447	— 19.3	6,133,214	8,190,244	103	105	149
New York	14				9			23	21	76	31,789	516	1,002	— 48.5	748,453	1,458,602	40	45	100
North Carolina													2	—100.0		7,971			
North Dakota	20			15				35	23	27	246,682	296	269	+ 10.0	2,076,265	1,924,042	25	25	28
Ohio	25		26	33				84	85	58	150,069	1,062	966	+ 9.9	2,108,972	1,968,814	196	192	188
Oklahoma	457	4	42	251			2	756	558	741	2,632,732	7,919	7,280	+ 8.8	27,055,491	25,555,956	675	672	656
Oregon													1	—100.0		1,894	1	1	
Pennsylvania	16		20	6	11	5		58	62	106	122,736	929	1,895	— 51.0	1,729,607	4,259,083	112	127	227
South Dakota				1				1	2	1	3,527	20	22	— 9.1	102,156	101,331	1	1	4
Tennessee													30	—100.0		34,226			
Texas	1,021	41	65	669	17	1	2	1,816	1,499	1,508	7,560,403	18,539	17,041	+ 8.8	82,279,758	77,793,633	1,371	1,302	1,328
Dist. 1: South Central	105			41				146	116	69	370,303	1,190	857	+ 38.9	3,797,362	2,738,947	48	40	24
Dist. 2: Middle Gulf	18	6	4	35				63	69	89	385,180	815	807	+ 1.0	4,993,068	4,959,409	35	31	41
Dist. 3: Upper Gulf	86	13	1	63				163	144	146	1,056,870	1,760	1,673	+ 5.2	11,698,015	11,239,267	132	127	120
Dist. 4: Lower Gulf-S.W.	43	15	6	45				109	104	148	534,957	1,413	1,833	— 22.9	7,353,949	10,394,598	71	75	70
Dist. 5: East Central	19		4	39				62	32	17	194,484	321	275	+ 16.7	1,208,106	1,099,049	19	20	9
Dist. 6: Northeast	38	5	22	38				103	69	51	590,232	777	516	+ 50.6	4,511,700	3,070,184	50	61	58
Dist. 7-B: North Central	160		5	166				331	254	229	934,458	3,035	3,111	— 2.5	9,524,987	10,081,832	155	142	150
Dist. 7-C: West Central	76		1	30				107	98	114	513,091	1,285	1,318	— 2.5	6,673,721	6,529,684	139	127	144
Dist. 8: West	230	1	2	49	11			293	215	222	1,627,509	2,892	2,373	+ 21.9	16,997,849	13,621,103	401	356	333
Dist. 9: North	192	1	3	153	6	1	2	358	337	306	1,080,764	4,098	3,658	+ 12.0	12,348,509	12,104,296	242	252	264
Dist. 10: Panhandle	54		17	10				81	61	117	272,555	953	620	+ 53.7	3,172,492	1,955,264	79	71	115
Utah				6				6	7	6	28,049	69	81	— 14.8	305,564	433,014	23	22	15
Virginia													26	—100.0		110,811			
Washington									1			6	2	+200.0	16,623	6,111		1	1
West Virginia	12		32	15				59	45	59	173,834	572	607	— 5.8	1,656,347	1,685,803	166	163	195
Wyoming	30		1	28				59	83	105	308,194	1,117	887	+ 25.9	5,909,032	4,444,739	76	79	134
Total United States	2,590	61	323	1,850	38	6	5	4,873	4,169	4,281	19,382,812	51,902	49,480	+ 4.9	209,501,937	198,431,603	4,680	4,685	4,802
Total Western Canada	191		16	95				302	225	181	1,229,701	2,271	2,226	+ 2.0	8,964,824	9,138,030	181	189	171

Completions Record Set

51,902 wells completed in 1954 top previous high of 1953 by 4.9 percent.

RECORDS FOR THE most active drilling year in the U. S. oil history show that a total of 51,902 new wells was completed in 1954 to top the previous high of 49,480 in 1953 by 4.9 percent. For the first time, the nation's drillers accomplished the 50,000-wells-in-a-year mark and had plenty to spare. Not too many years ago, that level was little more than a dream, and considered by many to be the ultimate that would perhaps never be reached.

Now it appears that the year just begun will, at least, see the performance repeated and become the second in a long string that will have 50,000 wells as a base just as 30,000 was ten years ago. A detailed forecast of 1955 drilling activity will be presented by WORLD OIL in the February 15 Forecast-Review issue.

While total wells was climbing 4.9 percent during 1954 over the previous year's, the amount of footage drilled in those wells showed a gain of 5.6 percent. The amount of footage drilled, is in reality a better measure of effort expended than the number of wells, and the comparison of footage showed the very encouraging fact that this year's drilling was accomplished with fewer rigs working than were in use in 1953.

Only one of the five top drilling states showed a drilling decline during the year, while the remaining saw substantial hikes. Texas, continuing its leadership, had 18,539 new wells completed within its bounds for a gain of 8.8 percent over 1953 activity. However, the increase in footage drilled did not quite match the gain in wells, but was more in line with the national average of 5.6 percent.

The Number 2 state, Oklahoma, likewise enjoyed an 8.8 percent increase to 7911 wells. Next in order came Kansas with the only decline of the top five. That state's wells dropped 5.2 percent to 4222 in 1954. Louisiana jumped its activity 33.6 percent over 1953 and ended with a total of 3650 wells completed. The largest percentage gain occurred in Illinois, where 3265 wells represented an increase of 50.8 percent.

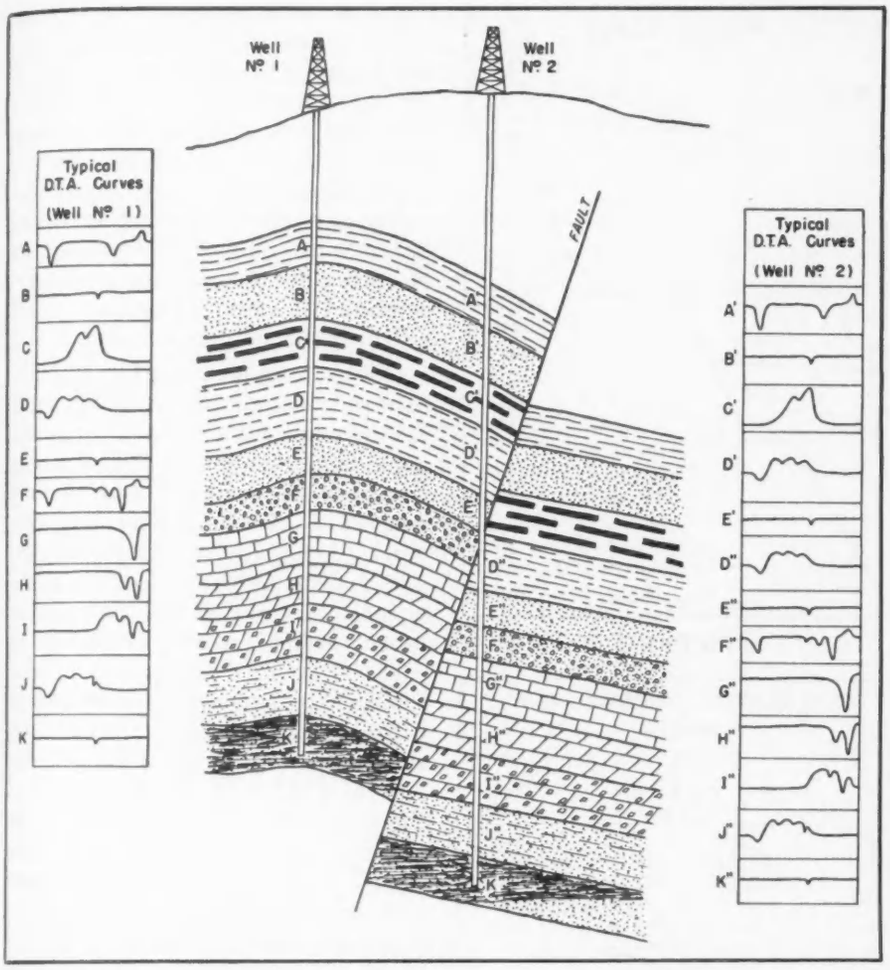

Fig. 1—Schematic correlation of zones with differential thermal analysis. Clay, sand, shale, limestone and other zones in Well 1 are correlated with those in Well 2 to show subsurface conditions. Zones are identified in each well by determining mineral composition of cuttings from those zones. Formations indicated: A—bentonitic clay; B—sand; C—lignite; D—shale; E—sand; F—conglomerate; G—limestone; H—dolomite; I—pyrite and dolomite; J—sandy shale, and K—oil sand.

DTA—a New Type of Formation Correlation

Differential thermal analysis is a relatively inexpensive method of accurately correlating formation zones from well to well.

By GEORGE B. MANGOLD, Petroleum Engineering Associates, Pasadena, Calif.

THE USUAL difficulty of accurately correlating formation zones from one well to another has led to the development of a relatively inexpensive method of arriving at such correlations. This method is based entirely on the primary composition of the mineral zones rather than on the presence in the zones of paleontological specimens or on secondary effects such as electrical resistance and radiation phenomena. This method is the differential thermal analysis (DTA) of carefully procured cuttings, a process that does not involve shutdown in drilling operations and one that minimizes the human element and individual difference in interpretation.

PART 1

In spite of the comparatively recent origin of DTA, it has already been given wide acceptance in fields of clay analysis and to a lesser extent in industrial process analysis. However, only a relatively few men in the petroleum industry understand the concepts and potentialities involved so that it seems advisable to present here a brief background of the theories and mechanisms of DTA before the actual applications to the industry are discussed.

Unlike most chemical analysis, spectrographic analysis, and the like, which identify elements and ions and usually provide little indication of the combination of atoms and molecules, DTA serves to inexpensively identify compounds and mineral composition. It is based on the fact that most substances undergo certain changes in crystal structure, physical state, chemical composition, or states of oxidation when they are subjected to variation of temperature. For instance, if a uniform amount of heat is steadily applied to a piece of ice, its temperature will rise to 0° C. at which point the temperature remains constant until melting is complete. As heating is continued, the temperature of the water rises but there is no further appreciable change in the physical or chemical state until 100° C. is reached. At this point the water changes to steam and will remain at 100° C. until all of the liquid has evaporated. Beyond this point the temperature again rises with continued heating. The processes of melting and evaporation are the result of heat absorption. The exact temperatures and the quantities of heat involved in the processes are accurately known. They are characteristic of the compound H_2O and may serve to identify it.

Consider another example in which a thermocouple,* connected to a pyrometer, is embedded in sulfur in a closed container. If heat is uniformly applied, the temperature noted on the

*A junction of two dissimilar metallic conductors. With the application of heat, an electric current is produced which is a function of the metals used and the temperature difference between the junction and the recording instrument.

pyrometer is seen to steadily rise to the melting point of the sulfur (cf. A-B, Figure 2). The temperature remains constant, B-C, until melting is complete, whereupon it again rises, C-D. Section D-E represents evaporation of the liquid sulfur, and E-F the rise in temperature of the gas. At point F, if oxygen is permitted to enter the container, burning or oxidation commences and is indicated by the sudden sharp rise in temperature, F-G.

If the thermal reactions of several materials are to be compared, this method of presentation would be awkward and cumbersome. An alteration of the mechanical setup allows the substance under study to be compared with a thermally-inert material rising at a uniform temperature rate. An identical thermocouple is placed in each of two sample holders, one of which contains—for the purpose of this illustration—the sulfur, and the other a material such as alumina (Al_2O_3) which after previous calcination will undergo no thermally-induced reactions within the temperature range to be covered. Both sample holders are symmetrically supported in a furnace which can be heated at a uniform rate. If each termocouple were connected separately to a recorder, the result of application of heat would be a curve on a temperature-vs-time graph similar to Figure 2 for the sulfur, and a straight sloping line for the inert alumina. Instead, however, one wire of one thermocouple is connected to the like wire of the other couple, and the remaining two wires led to the recording instrument. As a result, the absolute temperature of neither thermocouple is determined, but rather the difference in temperature between them. The use of such "differential" thermocouples leads to the term "differential thermal analysis" for the whole process.

Figure 3 portrays a differential thermal curve for the sulfur mentioned in the above example. At point B melting commences and is complete at C, although it is not until D that the temperature has become equal to that of the inert standard. At point E evaporation starts, becoming complete at F. With the introduction of oxygen, burning begins at point G and oxidation is complete at H.

The vertical axis of the differential thermal curve is called the base line. Whenever the sample is at the same temperature as the inert standard, the curve coincides with this axis. Peaks or curves to the right represent indothermic reactions in which most of the heat that is being absorbed is being utilized to push the reaction to completion. With less heat available for raising temperature during this reaction, the sample consequently lags behind the inert standard and does not catch up until after the reaction is complete. Similarly, peaks or curves to the left of the base line represent exothermic reactions in which the sample is hotter than the standard and is giving off heat. The area bounded by a peak and the base line is proportional to the amount of heat involved in a reaction and is therefore a measure of the mass concentration of the particular material causing the reaction. Because of the fact that individual compounds have different melting and boiling points, and because chemical bonds, physical combinations, crystal arrangements, and lattice structures are maintained with vastly different quantities of energy, the temperature and characteristics of a reaction provide an excellent means of identification.

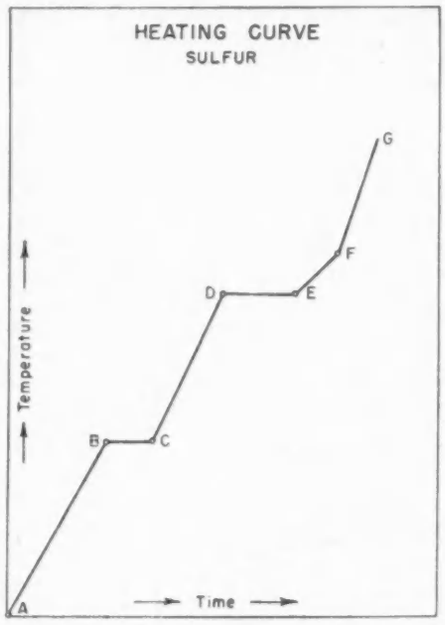

FIGURE 2

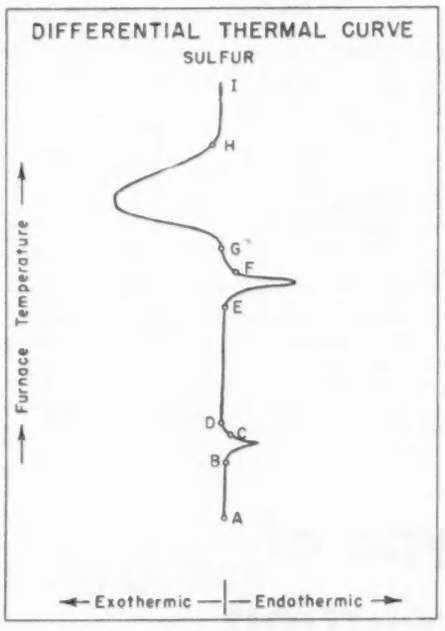

FIGURE 3

DTA curves of a number of common minerals are shown in Figure 4. A brief explanation of each curve will aid in understanding the type of results that may be obtained from thermal analysis. Curve A, representing alumina (Al_2O_3), is a straight vertical line, indicating that no thermal reactions occur within the temperature range covered (room temperature to 1000° C.). Curve B, quartz, shows one small sharp endothermic reaction at 573°C., representing the crystal inversion from α to β quartz. Curve C, calcite ($CaCO_3$), is thermally inert up to the large endothermic reaction in the neighborhood of 925°C., representing the decomposition of the carbonate and the expulsion of carbon dioxide. Curve D, dolomite ($MgCO_3 \cdot CaCO_3$), shows two endothermic peaks at about 780° C. and 925° C. respectively, representing the successive decompositions of magnesium carbonate and then calcium carbonate with the consequent loss of carbon dioxide. Curve E, siderite ($FeCO_3$), portrays the decomposition at 550° C. with loss of carbon dioxide. The remaining iron oxide (FeO) immediately oxidizes to Fe_3O_4 as indicated by the sharp exothermic peak at 600° C. The small exothermic bulge centered at about 750° C. represents the further oxidation to hematite (Fe_2O_3). Curve F, kaolinite, shows a strong endothermic reaction at 600° C. representing decomposition of the crystal lattice structure. At about 990° C. there is a sharp exothermic reaction due to recrystallization of amorphous alumina produced in the decomposition. Curve G, montmorillonite (Wyoming type), exhibits several well-defined peaks. The lower endothermic peak at about 160° C. represents the loss of water of hydration (not to be confused with moisture which may be adsorbed on the surface of any mineral and which would appear as an endothermic bulge in the neighborhood of 100° C.). The large endothermic peak at about 700° C. and the smaller one

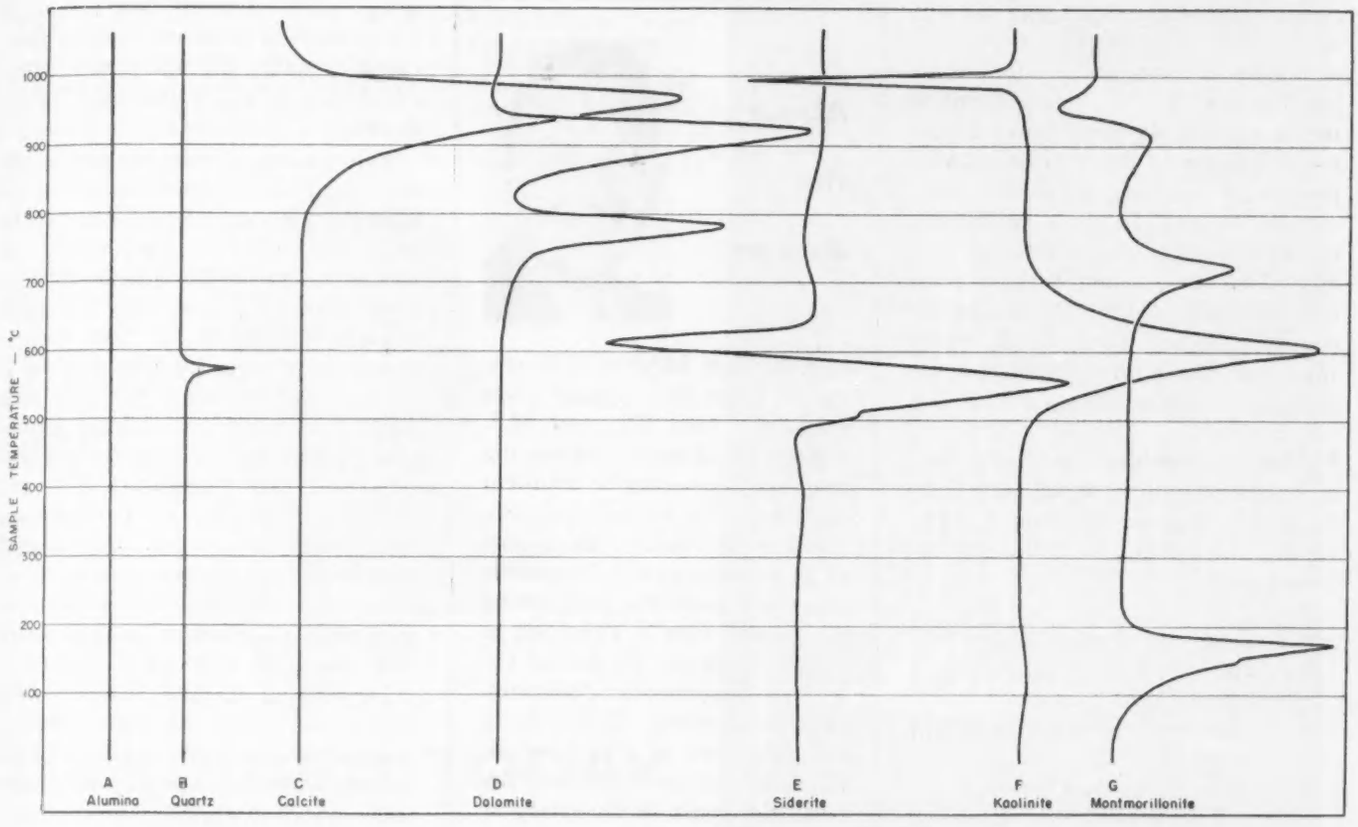

Fig. 4—Differential thermal curves of selected minerals.

at about 900° C. are due to the destruction of the lattice structure. After the final breakdown, crystallization of spinel results in the exothermic peak which follows immediately (about 950° C.).

Pure minerals such as these yield thermal curves that are easily recognizable. In most cases, mixtures of several minerals which have characteristic DTA curves can also be identified and approximate quantitative proportions assigned to them. Dilution of a particular mineral by other sample ingredients not only cuts down the amplitude of thermal reactions of that mineral but also usually lowers the temperatures of reaction. If one of the ingredients of a mixture is itself thermally inert, the effect on reaction temperature and amplitude of the other ingredients will be present but without identifying thermal peaks for this inert substance. Inasmuch as there are relatively few inert common minerals, the absence of thermal peaks can also be highly diagnostic.

In order to present a picture of the way in which the DTA curve of a complex mineral assemblage develops, refer to Figure 5. Curves A, B, and C represent selected portions of an actual ditch sample whose over-all DTA curve is shown as D. Curve A, of white and clear crystals making up approximately 20 percent of the total, indicates quartz and halite (NaCl). Curve B, from the dark grey fraction comprising about 40 percent of the total, shows a clayey shale containing a considerably pyrite content. Curve C, the light grey fraction also comprising about 40 percent of the complete sample, shows a concentrated dolomitic shale. With all three fractions combined in their proper proportion, Curve D results and is indicative of the mixture. Obviously, with progressively increasing number and complexity of mineral components, resultant thermal curves may not submit to easy analysis.

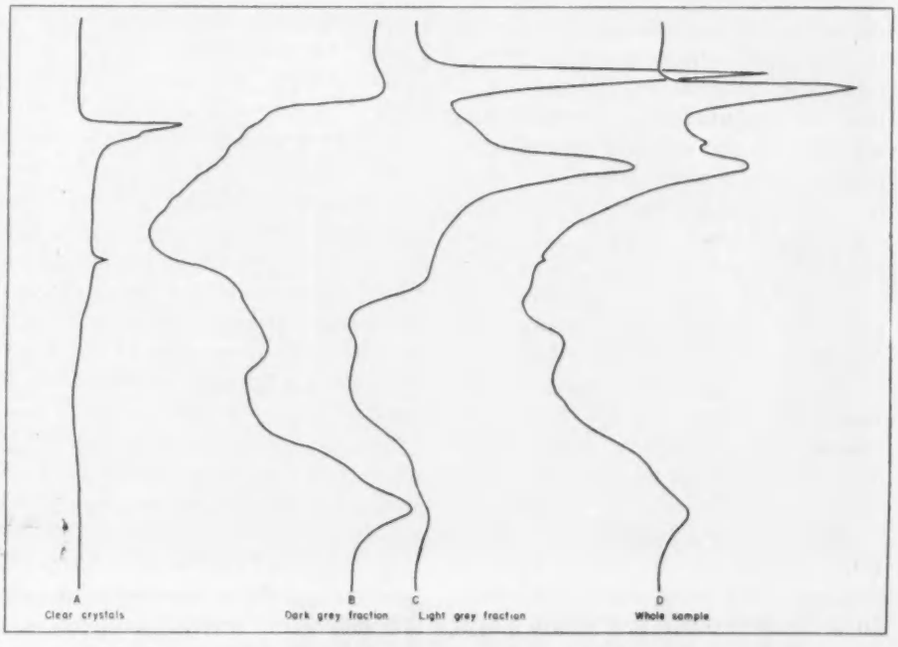

Fig. 5—Compounding a differential thermal curve (actual ditch cutting).

Nevertheless, this does not detract from the value of DTA for correlation

purposes because two or more mineral assemblages of identical composition, regardless of how complex that composition may be, will have identical thermal curves. In other words, correlation is based on the relatively simple process of spotting similarities and changes rather than upon the identification of individual components, but, as will be brought out later, a great deal of useful additional information can be obtained from DTA curves when one has achieved sufficient experience in their analysis.

Formation Correlation. Zonal formations encountered in oil well drilling may be examined and correlated to various degrees by the following accepted methods:

- Electric logs
- Radioactivity logs
- Visual (including microscopic) examination of cuttings
- Paleontological examination of cuttings
- Differential thermal analysis

Electric and radioactivity logs may be discussed together. They usually require the cessation of drilling and consequent cost of idle rig time. They are dependent on secondary effects within the formation rather than on the actual formation composition. The properties that are measured are complex resultants due to the mineral assemblages, particle sizes, type of cementation, surface phenomena, permeability, formation fluids, and even the type and composition of drilling fluid. Both types of logs serve very valuable purposes in the location and development of oil reservoirs but, except for restricted use within short distances and where the formations are accurately known, the limitations mentioned above sometimes preclude their use for extensive correlation.

The remaining correlation methods listed depend on the examination of cuttings (and cores when available). In a comparatively few recent years, cuttings have transcended the position of being an unavoidable evil to become a valuable by-product of drilling and an unexcelled source of information concerning the formations being drilled.

Any method of cutting examination has two advantages and a limitation independent of the particular analysis procedure involved. One advantage lies in the fact that no drilling time is lost in obtaining the basic material on which the examinations are made—no need to pull the pipe, no cost for idle crews. A second advantage lies in the fact that the cuttings are an actual part of the formation; accurate identification of the minerals or of the age of deposition is a positive identification of the zone from which they came.

The limitation lies in the ease of obtaining an erroneous sample; that is, without adequate sampling techniques, the exact depth from which the cuttings originated may be misinterpreted, incorrect washing may result in contaminated or deleted samples, and sloughing of shallower formations may inject alien fragments into the samples. This limitation, however, can be largely overcome by the exercise of proper care and judgment, and satisfactory techniques have been developed to make possible the securing of dependable samples in nearly all cases.

Visual examination yields only a cursory picture of the cuttings composition. It may show calcareous matter, crystalline quartz, and a few easily recognizable minerals, but mainly it serves only to point out approximate ratios of sand, silt, shale, and clay—which are primarily distinguished on the basis of particle size.

Paleontological examination is not concerned with composition of the cuttings but with microfauna that may be contained therein. Preparation of specimens is a lengthy job, and examination of them requires personnel specifically trained in this science. Zonal correlation by this method is widely accepted but, like all such tools, it is subject to several limitations which in this case include besides cost and specialized skill, frequent encounter of formations containing few or no microfaunal specimens, and controversial interpretation of formations wherein unusual migration of microfauna has taken place far back in geologic time.

Differential thermal analysis is the newest and one of the best of the correlation tools and gives promise of becoming widely used as soon as the petroleum industry grows fully cognizant of its potentialities. For several years there has been development of techniques and instrumentation for accurately and inexpensively recording differential thermal curves of the mineral assemblages found in oil well cuttings. Starting with single sample holders and recording instruments, a slow but steady accumulation of data was secured which proved the accuracy of the method and the validity of the theory. Instrumentation was developed and expanded to make possible multiple thermal curve recordings of six samples simultaneously with even greater precision and sensitivity than in the original single-sample method. Scores of pure minerals have been cataloged—singly, in combination, and in varying concentration.

A comprehensive handbook of standard mineral thermal curves is thus being gradually compiled and is ever being expanded and made more complete. At the same time, increasing numbers of correlative DTA logs are being prepared, including depths over 17,000 feet, and from a wide range of localities. As more and more data are accumulated and experience is gathered in correlating these data, is becomes increasingly simpler to evaluate formation zones from well to well and becomes increasingly more accurate.

—End Part 1

About the Author

GEORGE B. MANGOLD, registered chemical engineer, was graduated with B.S. and M.S. degrees in chemical engineering from the University of Southern California. He worked for many years in the research laboratories of Baroid Sales on developments in drilling muds and mud testing equipment, then in Venezuela as a mud engineer. He joined Petroleum Engineering Associates, Inc., in Pasadena, Calif., doing research work in drilling muds, oil well cements, and in DTA cutting analysis. In the spring of 1952, he was transferred to the associated company, Oil Properties Consultants, Inc., in the supervisory capacity as chief engineer of this work.

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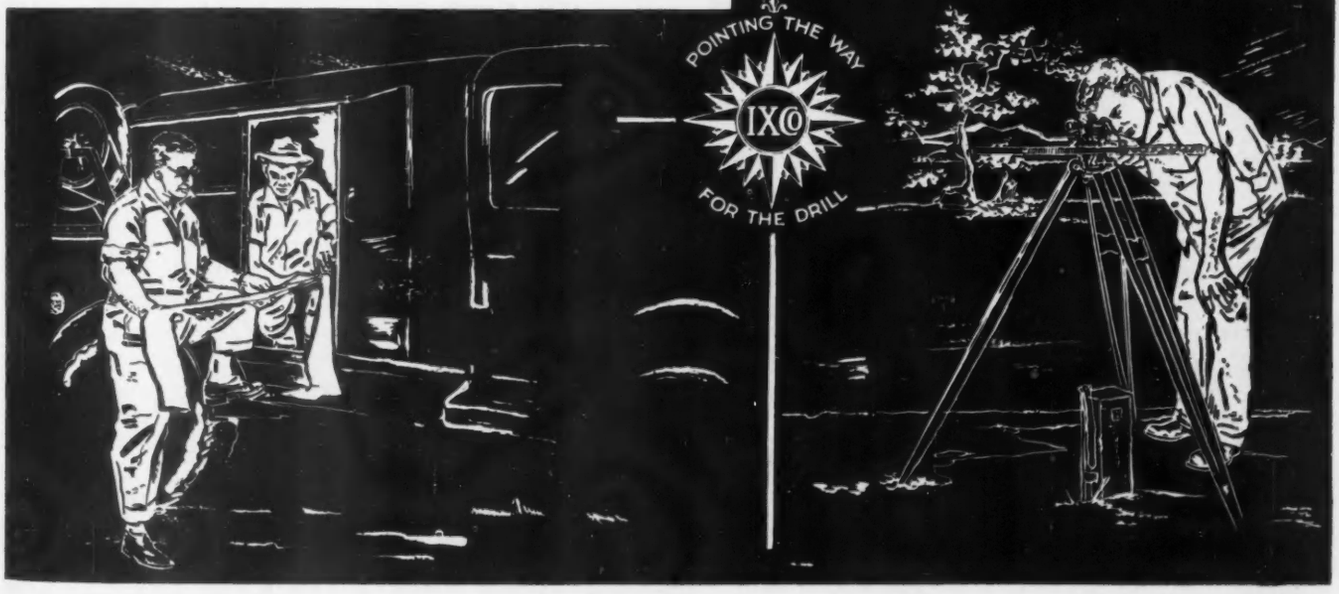

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Gravity Data Indicate Structural Conditions

Accurate interpretation of gravity meter data can reveal subsurface structural conditions responsible for mapped gravity anomalies.

By W. R. SYPE, Geologist, Stanolind Oil and Gas Company, Tulsa

DURING RECENT years there has been a good deal of interest in methods of treating gravity data so as to produce a map more directly related to possible geologic structure. Such methods are necessary because of the complexity of gravity data in many areas. Results of a survey usually are presented as a total gravity map, contoured on data which have been corrected for differences in surface densities, elevation, latitude, and terrain.

This total gravity map reflects all of the subsurface density differences which contribute to the gravitational field; it includes regional effects which sometimes obscure the local anomalies of possible structural interest, as well as smaller random effects comparable to "noise" in seismic work. Methods of processing the total gravity map are designed in general to remove regional gravity effects in order to emphasize the local anomalies.

Two recognized methods are used to accomplish this purpose: the derivative and residual. Both can be used to advantage in certain regions, although the derivative map is not so well adapted as is the residual to the problem of estimating geologic structural dimensions. This article therefore illustrates some of the uses of residual anomalies in developing ideas of subsurface structure.

The several procedures for constructing residual maps have been investigated in the literature, and are not discussed here. It is assumed that a suitable residual anomaly has been isolated, and the problem then is to determine what structural conditions could provide density distributions responsible for mapped gravity anomalies. Interpretation of gravity data with this objective requires:

- A reliable survey, using properly corrected values.
- At least approximate knowledge of subsurface densities.
- Understanding of the local geology, particularly of subsurface features likely to influence the gravitational field. Illustrations adapted from actual problems show how structure may be inferred from gravity data in several types of geologic provinces.

Salt Structure. Many of the early efforts of gravity interpretation were directed toward estimation of shallow salt dome dimensions. Publication of charts some years ago facilitated rapid computation of such dimensions, and by this time it is quite probable that gravity data have been used by somebody at one time or another to compute size and shape of every known or suspected salt structure in this country. Two diagrams illustrate the method.

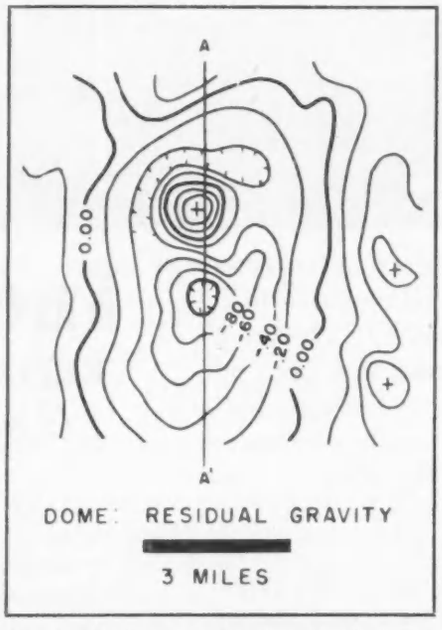

Fig. 1—Shallow salt dome: residual gravity anomaly (0.2 milligal contours).

Figure 1 is a residual gravity anomaly, developed by removing an estimated regional gravity gradient from the original fairly detailed gravity map, over a suspected but undrilled salt dome. The anomaly is a large gravity minimum within which a small maximum is evident. Salt is less dense than the sediments here, and so develops a gravity minimum; near-surface caprock, composed largely of anhydrite and gypsum, is heavier than surrounding sediments, and so produces a localized gravity maximum.

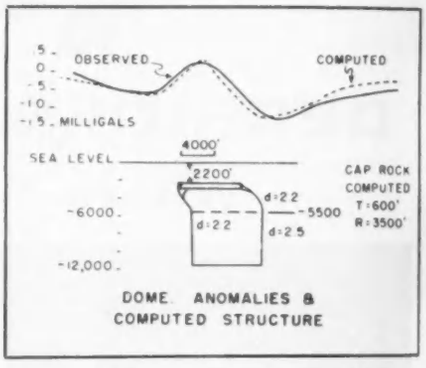

Fig. 2—Shallow salt dome: estimated structural dimensions, comparison of resulting anomaly profile with observed anomaly profile along Line A-A'.

Figure 2 shows the gravity profile on Line A-A', and shows also the dimensions of a salt dome, overlain by caprock, which would produce a similar anomaly profile. Overhanging caprock accounts for the offset local maximum. Top of caprock was estimated here at 2200 feet, and later drilled at approximatey 2400 feet; base of caprock-top of salt was estimated at 2800 feet, and later drilled at 2900 feet.

Deep-seated salt structures also develop anomalies from which dimensional estimates may be computed, which may lead to inferences concerning associated sedimentary structure.

Figure 3 is a residual gravity minimum over an oil field where production is associated with graben-type faulting. Here it is believed that a deep salt "ridge" accounts for the elongated anomaly, and that existing wells have not penetrated deep enough to encounter the top of the ridge, estimated at about 7000 feet below the surface. Figure 3 also shows horizontal

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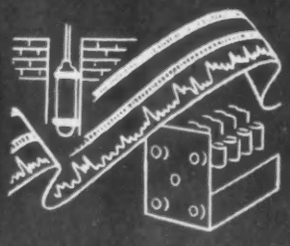

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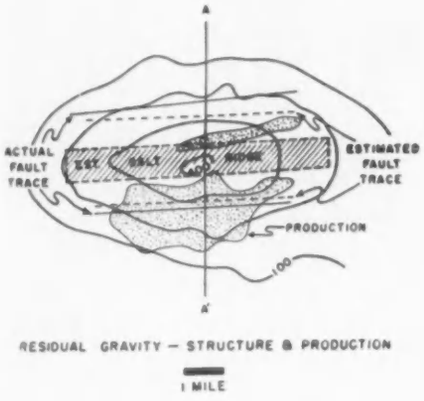

Fig. 3—Deep salt ridge: residual gravity minimum (1 milligal contours) production, estimated salt dimensions, generalized fault patterns.

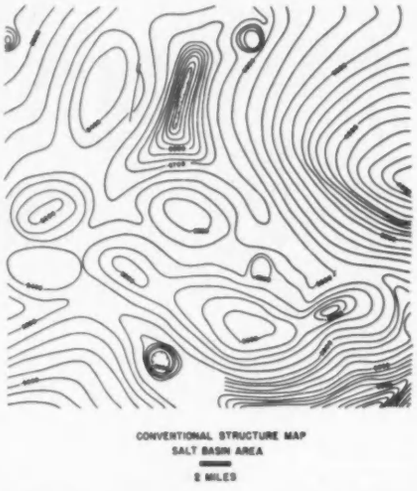

Fig. 5—Salt basin area: "conventional" structure map.

Fig. 7—Salt basin area: "fault-controlled" structure map, discovery (arrow) and offset wells.

dimensions of a salt mass which produces a similar anomaly, and indicates known as well as estimated fault patterns associated with the salt structure.

Figure 4 is a structure section along

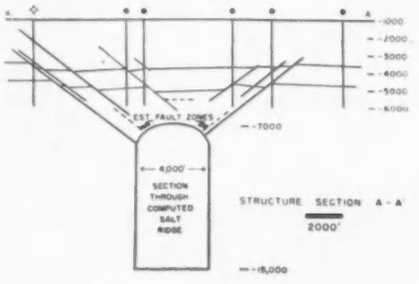

Fig. 4—Deep salt ridge: Line A-A′ structure section showing relation of proposed salt structure to known faults.

Line A-A′, based on subsurface control from wells, showing also the cross section of the proposed salt ridge and its relation to the known faults; it is assumed that the salt mass, in its upward growth, will have arched the overlying sediments, with consequent tension-faulting in the general pattern of the "estimated" fault zones as shown.

This trial run demonstrates that in salt-structure regions, gravity data may be used to suggest structural trends at depth and consequent fault patterns at least approximately. The next step is to see if the method may be applied in areas of imperfectly known structure.

Figure 5 shows an area of several townships in a region of known shallow salt domes and possible deeper salt features, contoured conventionally. Although there is production here, the region has by no means been drilled up, and it may offer structural possibilities in unexplored areas.

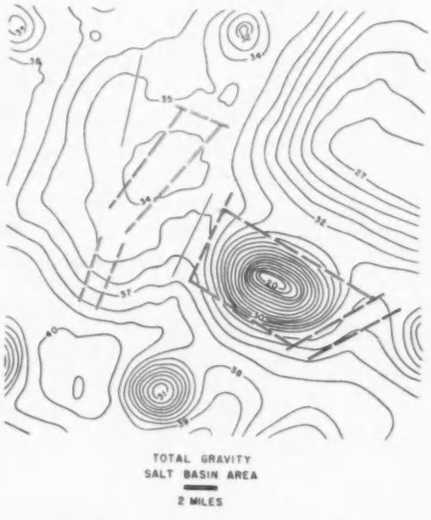

Fig. 6—Salt basin area: total gravity map (1 milligal contours) and suggested fault patterns.

Figure 6 shows the total gravity, contoured on one milligal, in the same region. This map includes regional as well as local anomalies. Shallow salt dome anomalies are obvious, and it is presumed that some of the low-gradient gravity minima may represent effects of undrilled salt structure at depth. If the presumed salt structures have developed corresponding fault patterns in the overlying sediments, these patterns can be diagrammed on the gravity map, as shown by the double dashed lines. The effect of such fault patterns on the regional structure is easily shown.

Figure 7 is a structure map of the area, based on exactly the same subsurface control as the previous structure map, but modified to show the influence of the fault systems on the general picture. This map also shows two wells; one, the discovery well (identified by arrow) drilled almost two years after the "fault-finding" map was made, which cut a 300-foot fault at approximately the estimated depth, and the offset, also a commercial well, which cut a "possible" 160-foot fault.

Other Types of Structure—Non-Salt. The gravity method is often used together with other exploration methods in efforts to determine structure, particularly when a single exploratory technique does not yield definitive data.

For example, in a mountain area, seismic data over a large surface structure provided evidence of gentle dips on both flanks, a steep-dip zone on one flank, and a "no data" zone below the structural crest. Gravity data developed a nine milligal anomaly, which could be explained by several quite different structures, each consistent with seismic information. Reconnaissance ground magnetic surveys, limited to three traverses, developed an anomaly suggestive of relatively shallow basement structure.

Figure 8 shows the transverse gravity and magnetic profiles across the area, and in addition, shows diagrams of two structures which will account for the gravity feature. Section A represents faulted Pre-Cambrian structure; Section B, essentially a faulty sedimentary fold. The latter would be less likely to account for the magnetic anomaly, and Section A is therefore

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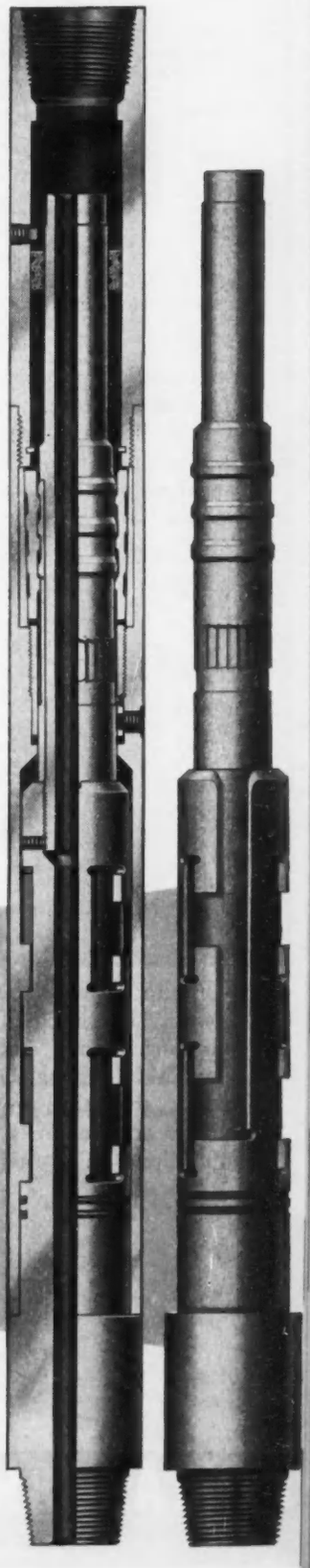

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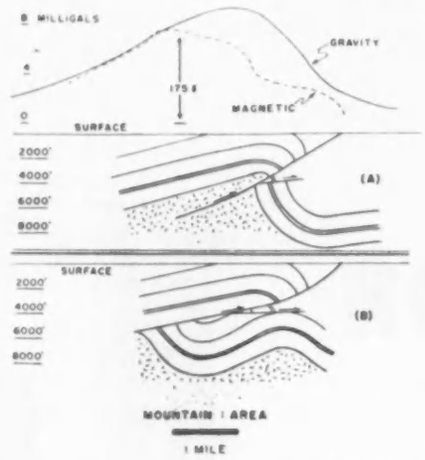

Fig. 8—Mountain area: gravity and magnetic profiles, and two possible structural interpretations.

presumed to approximate more closely the true structure.

Both diagrams account for a surface-mapped thrust fault, as well as for repetition of section in the subsurface.

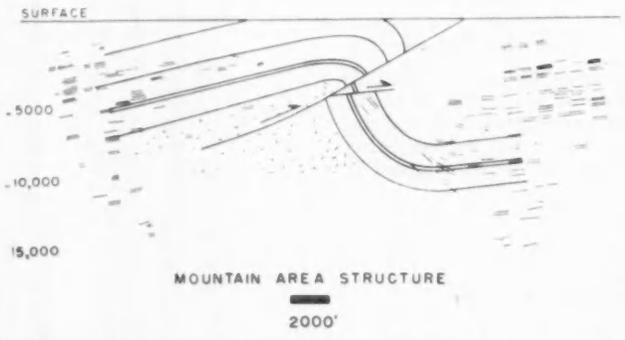

Fig. 9—Mountain area: preferred structural interpretation and seismic data.

Figure 9 shows the preferred Section A superimposed on the corresponding seismic section; and while there is fair agreement, yet it is apparent that the proposed structure fails to account for a number of seismic dips. This, then, represents an incomplete solution of a problem which needs additional data or better understanding of existing data.

Regions of considerably smaller structural relief offer problems for which gravity data may furnish useful approaches.

Figure 10 shows gravity and structure profiles from a region in West Texas. Here the topmost curve A represents a part of the gravity profile taken from a total gravity map. The inclined straight dashed line is considered to approximate the regional gradient; and the next Curve B, identified as "residual gravity," is the difference.

The San Andres structure profile D, since no data are available at this horizon, is derived from the Yates structure C. Samples from the region show density of material below top San Andres to be about 2.70, and overlying sediment densities about 2.45. Structure of about 250 feet, involving a density contrast of 0.25 at the San Andres horizon, develops an anomaly of approximately 0.8 milligal; this component of the mapped anomaly is shown as the dashed curve of B. But these data still leave a larger part of the anomaly, something over a milligal, unexplained. Sharpness of the observed anomaly in contrast to the low-gradient San Andres component suggests that much of the gravity feature is due to density variations, perhaps associated with similar structure at shallow levels.

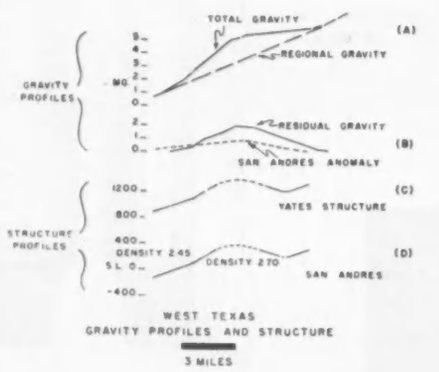

Fig. 10—West Texas: gravity and structure profiles.

The sample log, in fact, does show considerable variation in densities in an interval of about 600 feet above the top of the San Andres, which are probably grain densities to some degree; but in these zones the true bulk density is difficult, if not impossible, to ascertain with present methods which depend entirely on having good representative samples. Relatively small density contrasts at near-surface levels, if associated with shallow structure, develop mappable gravity anomalies; and if sufficient near-surface density were known, some of the smaller anomalies could be explained in terms of shallow structure.

In areas where there are insignificant density contrasts at depth, these inferred shallow structures then serve as possible indicators of similar features at depth. This approach should be valid for any type of structure, given reliable enough density data to explain quantitatively the shallow-type anomalies.

At present, experimental well-surveys are being conducted with a scattered gamma-ray type instrument which provides continuous data, from an open hole, that can be interpreted in terms of density. Such information, if available to sufficient depths over wide enough areas, should considerably enhance the value of gravity data and interpretations.

About the Author

WILLIAM R. SYPE, a native of Illinois, is a graduate of the University of Chicago with a B.S. degree in geology. Formerly employed with C. H. Frost Gravimetric Surveys, he joined Stanolind Oil and Gas Company in 1944. Sype was a geologist in Stanolind's general office in Tulsa until 1949, when he was made senior geologist in the division office at Oklahoma City. Since 1952 he has been a staff geologist in Stanolind's Tulsa office.

ACKNOWLEDGMENT

The writer expresses thanks to the Stanolind Oil and Gas Company for permission to publish this article; and acknowledges the assistance of many Stanolind geologists. Dr. Garvin L. Taylor provided background and suggested interpretive techniques. Dr. R. Clare Coffin supervised much of the earlier work. George V. Dunn and R. A. Weingartner encouraged these investigations. John G. Bartram and Dr. Taylor critically read the manuscript. W. W. Lamkin supervised the drafting of illustrations.

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—The End

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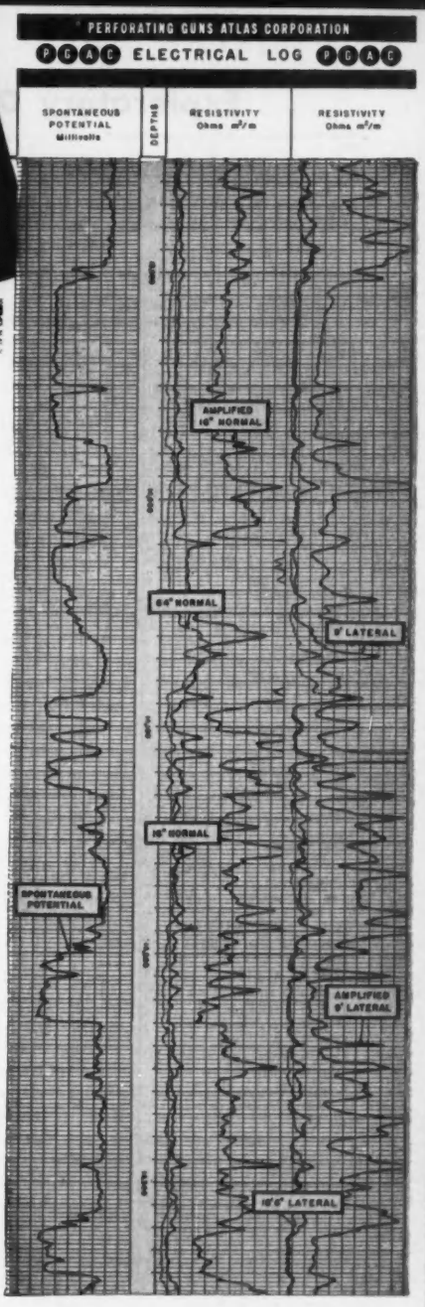

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Exploratory Drilling—In December and Total Year 1954-1953

State or District	MONTH OF DECEMBER, 1954													TOTAL YEAR, 1954																
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests									Total Productive		Unproductive Tests			Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions										
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	12 Mo. 1954	12 Mo. 1953	Wildcats	New Pays	Outposts	12 Mo. 1954	12 Mo. 1953	12 Mo. 1954	12 Mo. 1953
Alabama			1							1	1			1			2							2		59		1	60	80	60	80
Arizona																										8			8	6	10	6
Arkansas				2		1	1			4	13			17	3		1	6		2	4			16	31	108		4	112	137	128	168
California	1		1	1			1			4	31		1	36	23		7	11		1	6		2	50	89	348		8	356	468	406	557
Colorado	8		3				6			17	61		2	80	50	4	20	3		1	12		1	91	46	569		21	590	297	681	343
Florida											3			3	1									1		28			28	33	29	33
Georgia																										8			8	9	8	9
Idaho																										1			1	4	1	4
Illinois	2			4			7			13	49			62	26			34			64			124	86	594			594	460	718	546
Indiana											30			30	9		2							11	39	278			278	370	289	409
Iowa																														1		1
Kansas	17		3				1			21	89			110	123		30	4		1	7		1	166	175	765		12	777	879	943	1054
Kentucky	2									2	6			8	23		1							24	46	57			57	178	81	224
Louisiana	2	3	2	4	6			1		18	34		2	54	34	25	17	49	48	11	11	5	10	210	142	394		24	418	390	628	532
North Louisiana	1	3		1						5	19			24	7	4	3	8	3	4	4	1	2	36	25	174		4	178	205	214	230
South Louisiana	1		2	3	6			1		13	15		2	30	27	21	14	41	45	7	7	4	8	174	117	220		20	240	185	414	302
Maryland																									1						1
Michigan	1			1		1	1		1	5	22			27	12			1		1	2		1	17	28	217			217	254	234	282
Mississippi				1						1	21		1	23	5		1	1				1		8	28	176		6	182	203	190	231
Missouri																										6			6	10	6	10
Montana	3									3	10			13	9			3	2		2			16	15	104			104	115	120	130
Nebraska	1		1	1			4			7	28		1	36	30			4	2		8			44	27	159		8	167	137	211	164
Nevada											1			1	1									1		11			11	8	12	8
New Mexico	2		3		1		2		5	13	9			22	21	2	39	5	3	2	9		9	90	82	157		1	158	134	248	216
New York																									1				22		23
North Carolina																													2		2
North Dakota							1			1	9			10	2			2			3			7	15	110			110	82	117	97
Ohio											1			1							3		4	7	8	13			13	13	20	21
Oklahoma	8	2	2	2		1	6	1	1	23	83		2	108	107	14	19	29	1	2	67	4	4	247	289	726		28	754	709	1001	998
Oregon																															1	1
Pennsylvania									1	1				1									1	1	24	1			1	33	2	57
South Dakota											1			1	1									1		14			14	22	15	22
Tennessee																									2				18		20
Texas	50	4	9	36	9	2	9	3	1	123	407		4	534	538	73	94	277	59	23	116	17	17	1214	1136	4187		66	4253	4274	5467	5410
Dist. 1 S. Central	2			1						3	25			28	26	2	6	7	1	1	10	2	2	57	34	321		5	326	319	383	353
Dist. 2 Middle Gulf	1	2	3	1		1				8	23			31	7	14	16	8	3	5	3	1	3	60	67	270		4	274	280	334	347
Dist. 3 Upper Gulf	2	1		7	4			2		16	41		2	59	23	15	4	68	25	5	2	5	1	148	153	410		37	447	428	595	581
Dist. 4 L. Gulf-S.W.	2	1		5	3	1				12	28			40	25	23	6	60	22	5	2	6	2	151	195	366		7	373	484	524	679
Dist. 5 E. Central											20			20	2			1			1			5	10	155			155	115	160	125
Dist. 6 Northeast	1			2	1			1	1	6	26			32	4	4	1	5	3			1	1	19	27	177		2	179	147	198	174
Dist. 7-B N. Cent.	15		3	3			2			23	107			130	170	1	30	27			14		2	244	236	935		2	937	959	1181	1195
Dist. 7-C W. Cent.	3		1	5			1			10	25			35	49	4	11	19	1	2	10		3	99	95	350		3	353	356	452	451
Dist. 8 West	11			3			3			17	37			54	98	3	5	39	2	3	50	1	1	202	131	368		2	370	381	572	512
Dist. 9 North	13			9	1		3			26	70		2	98	129	4	4	41	1	1	23		1	201	184	777		4	781	786	985	970
Dist. 10 Panhandle			2							2	5			7	5	3	10	2	1	1	1	1	1	25	4	58			58	19	83	23
Utah											6			6	3		2							5	13	45		1	46	45	51	58
Virginia																													5		5
Washington																										5			5	2	5	2
West Virginia											1			1											11	3			3	5	3	16
Wyoming	1		1							2	23			25	58		8	7	1	1	6		1	82	47	217			217	141	299	188
Total U. S.	98	9	26	52	16	5	39	5	9	259	939		13	1211	10–79	118	250	433	112	45	320	27	51	2435	2381	9368		180	9548	9547	11,983	11,928

Wildcats Top 1953 Record

11,983 completions 0.5 percent over old mark.

By CECIL W. SMITH, WORLD OIL Staff

A NEW ALL-TIME high mark was set by the nation's exploratory drillers in 1954 by completing 11,983 tests. That was 55 wells or 0.5 percent more than the previous record of 11,928 drilled in 1953, and 594 more than the next highest level reached in 1952.

The year's exploration met with considerably more success than did previous years'. Increased success was not due entirely to the greater number of wells drilled. On a percentage basis the year's efforts held a substantial advantage.

New discoveries in 1954 totaled 2037 to top last year's record by 112 or 5.8 percent. Classed also as exploratory wells are field extension tests, and in this category the year's drilling slipped under the previous period's. Adding these extensions to discoveries to obtain total exploratory successes shows the year's campaign holding a somewhat smaller advantage of 2.3 percent. However, the finding of new pools of oil, distillate, or gas, which is the more important phase of exploration, enjoyed considerably greater success.

Summary of Results of Exploratory Drilling

ITEM	Dec., 1954	Nov., 1954	Total Year 1954	Total Year 1953	Percent Dif.
Oil Discoveries	150	129	1,512	1,458	+ 3.7
New Fields	98	92	1,079	1,062	+ 1.6
New Pays	52	37	433	396	+ 9.3
Distillate Discoveries	25	17	239	156	+ 47.4
New Fields	9	9	118	97	+ 21.6
New Pays	16	8	112	59	+ 89.8
Gas Discoveries	31	29	295	311	— 5.2
New Fields	26	27	250	259	— 3.5
New Pays	5	2	45	52	— 13.5
Total Discoveries	206	175	2,037	1,925	+ 5.8
Extension to Fields	53	41	398	456	— 12.7
Oil Fields	39	31	320	345	— 7.3
Distillate Fields	5	3	27	28	— 3.6
Gas Fields	9	7	51	83	— 38.6
Total Prod. Tests	259	216	2,435	2,381	+ 2.3
Dry Holes	952	818	9,548	9,547	.....
Wildcats	939	784	9,368	9,325	+ 0.5
New Pays	.....	.....	.....	21	—100.0
Outposts	13	34	180	201	— 89.6
Total Expl'tory Tests	1,211	1,034	11,983	11,928	+ 0.5
Percent Productive	21.4	20.9	20.3	20.0	.....
Percent Dry	78.6	79.1	79.7	80.0	.....

U. S. Discoveries in December

NEW FIELDS, NEW PAYS AND EXTENSIONS

ARIZONA—NEW GAS FIELD

Apache County. Shell Oil Co.'s East Boundary Buttes 2, SE NW 3-41n-28e, flowed 2.2 million from Hermosa sand, Pennsylvanian 4540-85 and 4650-90 feet. ⅜-inch, completed 10-20-54, TD 6339.

ARKANSAS—NEW OIL PAYS

Union County, Salem Church field. V. S. Parham's Powell 1-A, in 33-16s-18w, Old well worked over, pumped 84 barrels from Travis Peak sand, Lower Cretaceous 4296-4301 feet, 38.5-gravity, completed 12-15-54, TD 7064.

Union County, Schuler field. Exploration Drilling, Inc.'s E. M. Wooley 1, NW NE 28-18s-17w, pumped 70 barrels from Hill sand, Lower Cretaceous 3162-64 and 3168-69 feet, 42-gravity, completed 12-8-54, TD 3208.

ARKANSAS—NEW GAS PAY

Union County, El Dorado, East field, Spartan Drilling Co.'s A. A. Jerry 1, C SW SE SE 29-17s-14w, flowed 9.0 million from Tuscaloosa sand, Upper Cretaceous 3085-87 feet, open, completed 12-22-54, TD 5220.

ARKANSAS—OIL FIELD EXTENSION

Union County, Hillsboro field, Lawton Oil Corp.'s Olin O&G Co. B-1, C SE SW 7-18s-13w, flowed 5 barrels from Meakin sand, Upper Cretaceous 2565-76 feet, 12/64-inch, 18-gravity, completed 12-15-54, TD 2576.

CALIFORNIA—NEW OIL FIELD

Orange County, Sunset Beach area, Hancock Oil Co.'s Alamitos Land 1, in 13-5s-12w, flowed 313 barrels from 7298-7379 feet, 31.7-gravity, completed 12-23-54, TD 8976.

CALIFORNIA—NEW GAS FIELD

Kern County, Shafter field, Tide Water Associated Oil Co.'s Loepp 63-18, in 18-28s-25e, flowed 2.3 million from 4295-4305 feet, 16/64-inch, completed 12-9-54, TD 4325.

CALIFORNIA—NEW OIL PAY

Kern County, Dagany Gap field. Gilliland Oil Co.'s Barker 1, in 3-25s-18e, flowed 255 barrels from 1858-2150 feet, 19/64-inch, 40.6-gravity, completed 12-11-54, TD 2300.

CALIFORNIA—OIL FIELD EXTENSION

Kern County, Tejon field. Drilling & Production Co.'s "J. V." 33-33, in 33-11n-19w, northwest extension, pumped 439 barrels from Jewett sand, Miocene 7007-39 feet, 13/64-inch, 40-gravity, completed 12-8-54, TD 7066.

COLORADO—NEW OIL FIELDS

Jackson County. Lion Oil Co.'s Swinell 1, C NE SW 23-10n-79w, pumped 195 barrels from Dakota sand, Upper Cretaceous 4561-70 feet, completed 12-7-54, TD 4673.

Logan County. New Drilling Co.'s Allen 1, SW SE 35-10n-54w, pumped 127 barrels from Dakota "D" sand, Upper Cretaceous 4920-36 feet, completed 12-27-54, TD 5087.

Morgan County. Skelly Oil Co.'s P. F. Peterson 3, SW SW NW 13-1n-56w, flowed 228 barrels oil and 22 barrels water from Dakota "D" sand, Upper Cretaceous 5018-36 feet, ¾-inch, completed 12-10-54, TD 5205.

Washington County. Kimbark Co., Ltd., & Sterling Drilling Co.'s Porter 1, C SW SW 30-2s-55w, pumped 85 barrels from Dakota "J" sand, Upper Cretaceous 4984-87 feet, completed 12-9-54, TD 5150.

Unnamed field. Kingwood Oil Co.'s Snyder 2, SW SE 2-2n-54w, flowed 240 barrels from Dakota "J" sand, Upper Cretaceous 4808-14 feet, 18/64-inch, completed 12-31-54, TD 4859.

Unnamed field. New Drilling Co.'s McFarland 1, C NE NE 4-3s-56w, pumped 26 barrels from Dakota "J" sand, Upper Cretaceous 5077-81 feet, completed 12-28-54, TD 5225.

Unnamed field. Petroleum, Inc.'s Larsen 1, C NE NW 19-1s-55w, pumped 95 barrels from Dakota "D" sand, Upper Cretaceous 4914-20 feet, open, completed 12-11-54, TD 5180.

Weld County, White Buttes area. V. O. King & New Drilling Co.'s Government 1, C SW NE 26-8n-56w, flowed and pumped 210 barrels oil and 20 barrels water from Dakota "J" sand, Upper Cretaceous 5760-64 feet, ¼-inch, TD 5812.

COLORADO—NEW GAS FIELDS

La Plata County. Pubco Development, Inc.'s Pubco-Ute Indian 1, NE SW SE 9-33n-9w, flowed 2.4 million from Fruitland sand, Upper Cretaceous 2540-2804 feet, open, completed 11-18-54, TD 2804.

Unnamed field. U. S. Smelting, Refining & Mining Co.'s South Ute 1-21, flowed 500,000 or 0.5 million, from Fruitland sand, Upper Cretaceous 2550-3025 feet, open, completed 10-13-54, TD 3025.

Logan County. Eddie Fisher's Smith 1, SW SW NE 23-9n-55w, flowed 840 barrels water from Dakota "D" sand, Upper Cretaceous 5415-18 feet, 4.0 million, open, completed 11-20-54, TD 5582.

COLORADO—OIL FIELD EXTENSIONS

Adams County, Leader field. Ginther, Warren & Ginther's Leasure 3, NW NW NW 17-2s-59w, flowed 288 barrels from Dakota "J" sand, Upper Cretaceous 6249-54 feet, ¾-inch, completed 12-12-54, TD 6363.

Logan County, Pawnee Creek field. H. C. Arnold & Calvert Drilling Co.'s State 4441 1, SE SE SE 34-8n-54w, pumped 178 barrels from Dakota "J" sand, Upper Cretaceous 5024-32 feet, completed 11-22-54, TD 5032.

Morgan County, Gary field. H. L. Hunt's George E. Huey et al 6, C NW NW 27-2n-56w, north extension, pumped 140 barrels from Dakota "D" sand, Upper Cretaceous 5068-75 feet, completed 11-30-54, TD 5161.

Washington County, Bobcat field. T&T Oil Co.'s Stites 1, NW NE NE 17-1s-56w pumped 84 barrels from Dakota "D" sand, Upper Cretaceous 5193-95 and 5197-5201 and 5203-07 feet, completed 12-1-54, TD 5214.

Big Beaver field. New Drilling Co.'s Blomenkamp 2, C SE NE 17-3s-56w, pumped 550 barrels from Dakota "J" sand, Upper Cretaceous, completed 10-28-54, TD 5090.

Weld County, Roggen field, Nebraska Drillers, Inc.'s John Mitzel 1, NE NW NE 26-2n-63w, south extension, flowed 150 barrels from Dakota "D" sand, Upper Cretaceous 7036-44 feet, 24/64-inch, completed 12-15-54, TD 7164.

KANSAS—NEW OIL FIELDS

Barber County, Aurora Gasoline Corp. & Berwick Drilling Co.'s Cudeman 1, NW NW NE 10-35s-10w, flowed 593 barrels from Viola lime, Ordovician 5153-62 feet, TD 5485.

Unnamed field. Purcell & Mull's Burns 1, NW NW NE 23-33s-11w, pumped 20 barrels oil 3 barrels water from Mississippi lime, Mississippian 4496-4514 feet, TD 4610.

Barton County. Coppinger Drilling Co. & McMahon's Boyle 1, NE SE NE 17-17s-14w, pumped 25 barrels from Arbuckle lime, Ordovician 3450-59 feet, TD 3459.

Unnamed field. Herma-Burt Drilling Co.'s Murphy 1, NE NE NE 23-20s-13w, pumped 190 barrels from Lansing lime, Pennsylvanian 3336-41 feet, TD 3510.

Unnamed field. L. K. Parrish's Hagen 1, SW SE SE 20-20s-11w, pumped 25 barrels from Arbuckle lime, Ordovician 3330-34 feet, TD 3334.

Unnamed field. Pabco & Francis Raymond's Simmons 1, SE SE SW 3-18s-11w, pumped 25 barrels from Lansing lime, Pennsylvanian 3094-3106 feet, TD 3362.

Ellis County, Herman field. Mallonee & Sutton's Herman 1, NW NW NE 28-13s-20w, pumped 199 barrels from Arbuckle lime, Ordovician 3863-75 feet, TD 3875.

Ellsworth County. The Texas Co.'s Urbanek 1, NW NW SE 15-16s-10w, pumped 237 barrels oil and 43 barrels water from Arbuckle lime, Ordovician 3413-18 feet, TD 3431.

Graham County, Hoof field. Imperial Drilling Co.'s Hoof 1, NE NE SW 9-10s-23w, potentialed 3000 barrels from Lansing lime, Pennsylvanian 3865-95 feet, TD 3955.

Harper County. Earl Wakefield's Dusenberry 1, SE NE NW 3-32s-9w, pumped 25 barrels from Mississippi lime, Mississippian 4443-61 feet, TD 4525.

Kingman County. Greenland Drilling Co.'s Viney 1, NE NE NW 19-28s-5w, pumped 127 barrels from Mississippi lime, Mississippian 3884-90 feet, TD 3917.

Marion County, Youk field. Anderson-Prichard Oil Corp.'s Youk 2, N½ S½ S½ 20-18s-2e, pumped 55 barrels from Viola lime, Ordovician 3019-20 feet, TD 3020.

Pawnee County. Rine Drilling Co.'s Lovett 1, NW NW NW 35-22s-15w, pumped 54 barrels from Lansing lime, Pennsylvanian 3682-90 feet, TD 4041.

Phillips County. Wolf Creek field. Jones, Shelburne & Farmer's Bales 1, NE NE SW 16-4s-19w, pumped 20 barrels from Lansing lime, Pennsylvanian 3212-3312 feet, TD 3607.

Rush County, Webs field. Natural G&O Co. & Republic Natural Gas Corp.'s Eva Webs 1, NE NE NE 16-19s-20w, pumped 3000 barrels from Conglomerate sand, Pennsylvanian 4204-18 feet, TD 4700.

Summer County, H. Bachus & Sons' Barton 1, NW NW SE 1-35s-2e, pumped 25 barrels from Bartlesville sand, Pennsylvanian 3520-30 feet, TD 3536.

Unnamed field. Royal Oil Co.'s Cavenaugh 1, NE NE NW 25-34s-1e, pumped 25 barrels from Cleveland lime, Pennsylvanian 3164-74 feet, TD 3570.

KANSAS—NEW GAS FIELDS

Kingman County. Heathman-Selligson's Wooldridge 1, SW SE NE 16-27s-7w, flowed 1.0 million from Mississippi lime, Mississippian 3825-30 feet, open, TD 4303.

Unnamed field. Time Petroleum Corp.'s Folkes 1, SE SE NW 32-30s-9w, flowed 6.0 million from Mississippi lime, Mississippian 4325-35 feet, open, TD 4835.

Pawnee County. Homaker & Derby Oil Co.'s Boyd 1, SW SW SW 35-22s-17w, flowed 3.5 million from Conglomerate sand, Pennsylvanian 4156-62 feet, open, TD 4270.

KANSAS—OIL FIELD EXTENSION

Harper County. Earl Wakefield's Dusenberry 2, NE NE NW 34-31s-9w, 1-mile north extension, pumped 25 barrels from Mississippi lime, Mississippian 4422-98 feet, TD 4463.

KENTUCKY—NEW OIL FIELDS

Christian County. Walter Sargent et al's Littlepage Minerals 1, in 1-G-26, pumped 96 barrels from Jackson sand, Mississippian 648-65 feet, TD 665.

Henderson County. Stouder Drilling Co.'s Virginia Priest 1, in 6-P-25, pumped 152 barrels from O'Hara lime, Mississippian 2254-59 feet, TD 2261.

NORTH LOUISIANA—NEW OIL FIELD

Grant Parish Mill Creek field. Clay Oil & Gas Corp.'s Urania 1, in 24-7n-1e, pumped 31 barrels from Sparta sand, Eocene 1813-17 feet, 18-gravity, completed 11-26-54, TD 1817.

NORTH LOUISIANA—NEW DISTILLATE FIELDS

DeSota Parish. Natural Gas & Oil Co.'s P. H. Holmes 1, in 21-13n-16w, Old Well Worked Over, flowed 9 barrels distillate, 472 barrels water and 5.9 million from Rodessa lime, Lower Cretaceous 5364-68 feet, open, completed 12-29-54, TD 6743.

Unnamed field. N. B. Hunt's Ray P. Oden 1, in 35-14n-14w, flowed 225 barrels distillate and estimated 18.5 million from Eagleford sand, Upper Cretaceous 2854-62 feet, open, completed 12-1-54, TD 6900.

Franklin Parish, Baker field. Marshall Steffenson's John H. Baker 1-A, in 35-16n-9e, flowed unestimated distillate and 1.0 million from Tuscaloosa sand, Upper Cretaceous 5169-75 feet, 10/64-inch, completed 12-27-54, TD 5306.

NORTH LOUISIANA—NEW OIL PAY

Claiborne Parish, Antioch field. Stanolind's Mary Ann Washington 1, in 28-22n-5w, flowed 193 barrels from Smackover lime, Jurassic 10,358-435 feet, 10/64-inch, 53-gravity, completed 12-2-54, TD 10,994.

SOUTH LOUISIANA—NEW OIL FIELD

Plaquemines Parish, South Pass area. Shell Oil Co.'s State Lease 1008 1-B, Gulf of Mexico, flowed 225 barrels from 7400-10 feet, 10/64-inch, 32-gravity, completed 12-6-54, TD 7500.

SOUTH LOUISIANA—NEW GAS FIELDS

LaFourche Parish, South Thidabaux area. Stanolind's Ridgefield Inc. 1, in 20-15s-16e, not perforated nor potentialed, completed 12-12-54, TD 14,027.

Terrebonne Parish. Humble O&R Co.'s LLE 1-P, in 22s-15e, not perforated nor potentialed, completed 12-1-54, TD 15,025.

SOUTH LOUISIANA—NEW OIL PAYS

Jefferson Parish, Grand Isle-Block 18 field. Humble's State Lease 798 3-D, Gulf of Mexico, flowed 196 barrels from 8276-96 feet, ⅛-inch, 32.7-gravity, completed 12-4-54, TD 9347.

Plaquemines Parish, Main Pass-Block 69 field. The California Co.'s State Lease 1354-4, Gulf of Mexico, flowed 194 barrels from 7302-22 feet, 10/64-inch, 29-gravity, completed 12-27-54, TD 8406.

St. Mary Parish, Eugene Island-Block 18 field. Shell's State Lease 1665-1, Block 13, Gulf of Mexico, flowed 220 barrels from 9075-78 feet, 35.1-gravity, completed 12-6-54, TD 11,500.

SOUTH LOUISIANA—NEW DISTILLATE PAYS

Acadia Parish, Rayne field. Continental Oil Co. & Sun Oil Co.'s Gerard Mouton 1, in 47-9s-2e, flowed 348 barrels distillate and 6.3 million from Nodosaria sand, Miocene 13,277-490 feet, 12/64-inch, 49.5-gravity, completed 12-5-54, TD 14,005.

Beauregard Parish, Cowpen Creek field. Sun et al's Walker-Long Bell 1, in 9-6s-9w, Old Well Worked Over, flowed 100 barrels distillate and 0.8 million from 6842-52 feet, 44-gravity, completed 11-18-54, TD 8656.

Jefferson Davis Parish, Lake Arthur field. Union Sulphur & Oil Corp.'s Wallace J. Broussard et al 1, in 33-10s-4w, flowed 138 barrels distillate and 3.3 million from Marginulina sand, Oligocene 10,909-932 feet, 12/64-inch, 43.2-gravity, completed 12-29-54, TD 13,450.

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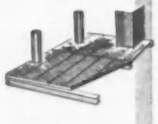

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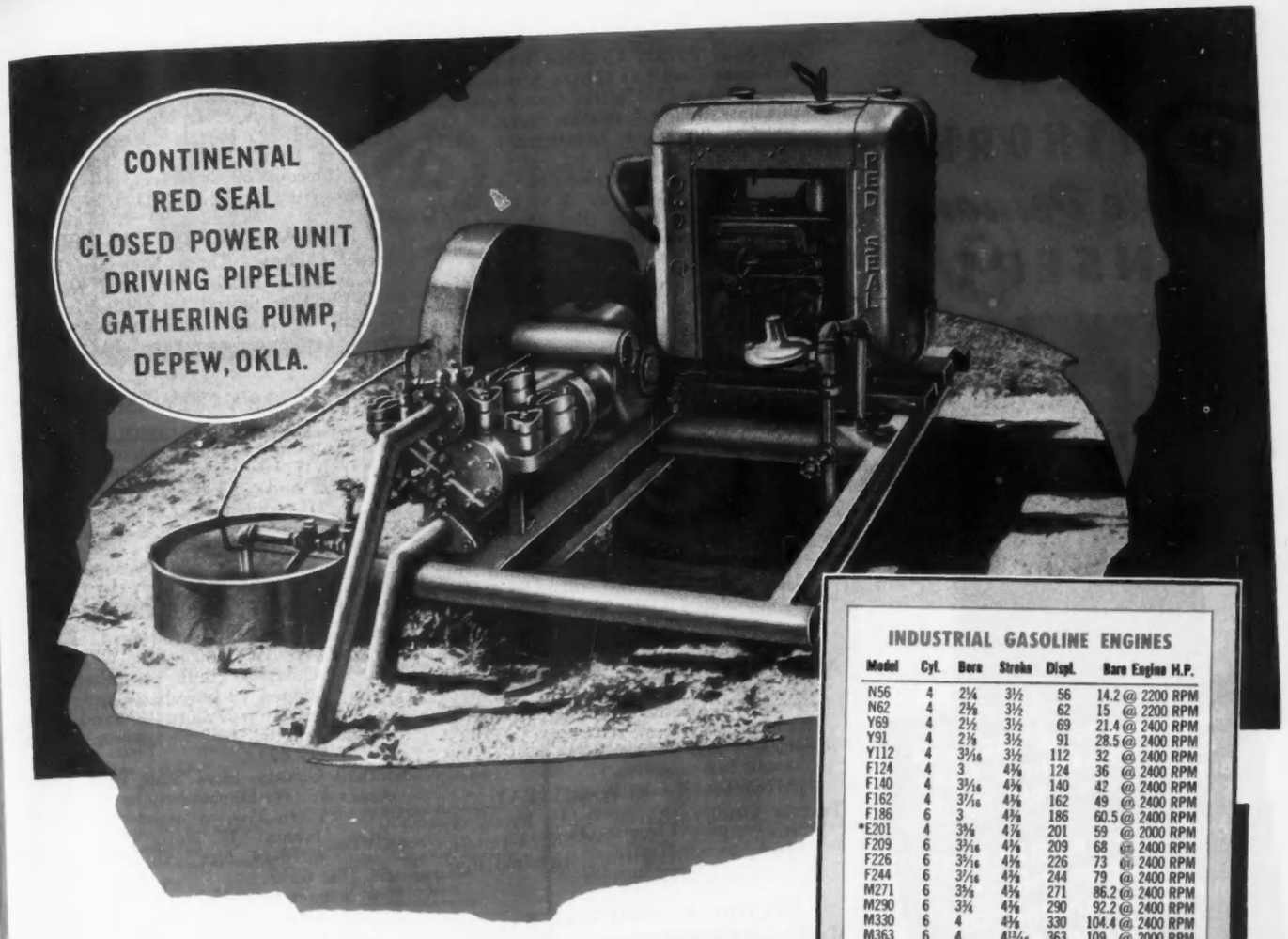

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INDUSTRIAL GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.2 @ 2200 RPM
N62	4	2⅜	3½	62	15 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 3/16	3½	112	32 @ 2400 RPM
F124	4	3	4⅜	124	36 @ 2400 RPM
F140	4	3 3/16	4⅜	140	42 @ 2400 RPM
F162	4	3 3/16	4⅜	162	49 @ 2400 RPM
F186	6	3	4⅜	186	60.5 @ 2400 RPM
*E201	4	3⅜	4⅜	201	59 @ 2000 RPM
F209	6	3 3/16	4⅜	209	68 @ 2400 RPM
F226	6	3 3/16	4⅜	226	73 @ 2400 RPM
F244	6	3 3/16	4⅜	244	79 @ 2400 RPM
M271	6	3⅜	4⅜	271	86.2 @ 2400 RPM
M290	6	3¾	4⅜	290	92.2 @ 2400 RPM
M330	6	4	4⅜	330	104.4 @ 2400 RPM
M363	6	4	4 11/16	363	109 @ 2000 RPM
B371	6	4⅛	4⅝	371	110 @ 2400 RPM
B427	6	4 5/16	4⅛	427	127 @ 2400 RPM
G134	4	3½	4⅜	134	32.2 @ 2000 RPM
G157	4	3⅜	4⅜	157	37.7 @ 2000 RPM
H227	4	3⅝	5½	227	52 @ 1800 RPM
H243	4	3¾	5½	243	56 @ 1800 RPM
*H260	4	3⅞	5½	260	60 @ 1800 RPM
T371	6	4⅛	4⅝	371	119 @ 2400 RPM
*J382	4	4½	6	382	74.2 @ 1400 RPM
T427	6	4 5/16	4⅛	427	140 @ 2400 RPM
U501	6	4½	5¼	501	160 @ 2400 RPM
R513	6	4½	5⅜	513	164.3 @ 2400 RPM
R572	6	4¾	5⅜	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅜	602	191.7 @ 2400 RPM
V603	8	4¼	4¼	603	240 @ 3200 RPM
S749	6	5⅛	5½	749	217 @ 2200 RPM
S820	6	5¼	5½	820	237 @ 2200 RPM

INDUSTRIAL DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
GD157	4	3⅛	4⅜	157	39 @ 2000 RPM
*ED201	4	3⅜	4⅞	201	45.8 @ 2000 RPM
HD243	4	3¾	5½	243	54.7 @ 2000 RPM
*HD260	4	3⅞	5½	260	59.3 @ 2000 RPM
*JD382	4	4½	6	382	72.5 @ 1600 RPM
TD427	6	4 5/16	4⅛	427	106.5 @ 2000 RPM
RD572	6	4¾	5⅜	572	142.5 @ 2000 RPM
VD603	8	4¼	4¼	603	182 @ 2800 RPM
SD802	6	5 5/16	5½	802	202 @ 1800 RPM

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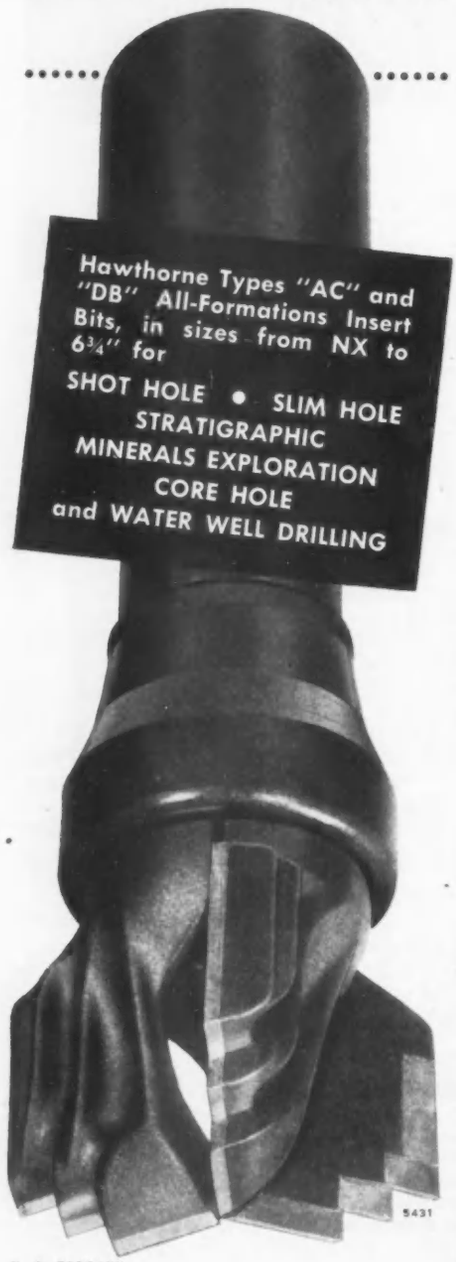
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Terrebonne Parish, Crescent Farms field. Arkansas Fuel Oil Corp's Southdown Sugars 2, in 81-17s-16e, flowed ungaged distillate and 2.4 million from 12,519-522 feet, 9/64-inch, completed 12-18-54, TD 12,590.

Kent Bayou field. Superior Oil Co.'s Continental Land & Fur 3-A, in 36-17s-13e, flowed ungaged distillate and 10.3 million from 9126-35 feet, 24/64-inch, completed 12-9-54, TD 11,200.

Vermilion Parish, Live Oak Plantation field. Houston Oil Co.'s Frank A. Godchaux 3, in 88-14s-3e, flowed 76 barrels distillate and 4.6 million from 12,238-246 feet, 14/64-inch, 46.6-gravity, and 79 barrels distillate and 4.5 million from 12,490-495 feet, 14/64-inch, 45.9-gravity, completed 11-29-54, TD 13,145.

SOUTH LOUISIANA—DISTILLATE FIELD EXTENSION

Jefferson Davis Parish, Lake Arthur field. Union Sulphur's Maple C. Hughes 1-B, in 34-10s-4w, ½-mile extension, flowed 48 barrels distillate and 3.4 million from 11,900-940 feet, 10/64-inch, 39.4-gravity, completed 11-30-54, TD 12,385.

MICHIGAN—NEW OIL FIELD

Montcalm County. E. Edwin Brehm et al's Jeppesen 1, NW SE NE 3-11n-7w, Douglas Township, pumped 25 barrels from Traverse lime, Devonian 2995-3045 feet, TD 3448.

MICHIGAN—NEW OIL PAY

Tuscola County, Akron field. Byron A. Bartlett's Elek 1, NE SW SE 23-14n-7e, pumped 31 barrels from Richfield lime 3778-89 feet, TD 3901.

MICHIGAN—NEW GAS PAY

Washtenaw County, Northville field. W. C. Taggart's Wilson-Buers 3, NW SE SW 1-1s-7e, flowed 5.4 million from Trenton sand, Ordovician 4012-4224 feet, TD 4224.

MICHIGAN—OIL FIELD EXTENSION

Muskegon County, Ravenna field. R. W. Devine, J. W. Lang Co. & R. W. Smith's Skelpinski 1, SW NE NE 28-9n-14w, ½-mile east extension, flowed 144 barrels from Traverse lime, Devonian 1862-63 feet, TD 1863.

MICHIGAN—GAS FIELD EXTENSION

Wayne County, Northville field. Woodson Oil Co.'s Daughters of St. Mary of Providence 1, SE SW NE 17-1s-8e, southeast extension, flowed 0.2 million from Trenton lime, Ordovician topped at 3989 feet, TD 4419.

MISSISSIPPI—NEW OIL PAY

Wilkinson County, Lake Mary field. Jett-Regen-Sadler et al's Kee 3, C NW SE NE 29-3n-4w, flowed 122 barrels from Wilcox "Kee" sand, Eocene 7537-41 feet, 6/64-inch, 43-gravity, completed 12-4-54, TD 7787.

MONTANA—NEW OIL FIELDS

Glacier County, Reagen area. Union Oil Co.'s Tribal 194-26, SE NE 27-37n-7w, pumped 39 barrels from Madison lime, Mississippian 3807-17 feet, completed 12-2-45, TD 3818.

Roosevelt County. Carter Oil Co.'s Tribal 1, C SW SW 5-29n-50e, pumped 72 barrels oil and 8 barrels water from Mississippi lime, Mississippian 6448-68 feet.

Teton County, Bonnatyne area. M. K. N. Oil Co.'s Skoog 1, SE NE NW 5-25n-1e, pumped 30 barrels from Sunburst sand, Lower Cretaceous 1499-1544 feet, completed 11-16-54, TD 1544.

NEBRASKA—NEW OIL FIELD

Kimball County. Rock Hill Oil Co.'s Frank Vrtatko 1-A, NE NE SE 7-13n-54w, pumped 225 barrels oil and 56 barrels water from Dakota "D" sand, Upper Cretaceous 6002-09 feet, 40-gravity, completed 11-29-54, TD 6174.

NEBRASKA—NEW GAS FIELD

Deuel County. Kansas-Nebraska Natural Gas Co.'s Troelstrup 1-C, NW SE SE 2-12n-42w, flowed 2.8 million from Dakota "D" sand, Upper Cretaceous 3164-72 feet, open, completed 11-29-54, TD 3224.

NEBRASKA—NEW OIL PAY

Kimball County, Swearingen area. L. J. Williamson et al's Swearingen 3, NW NW NW 10-14n-55w, pumped 272 barrels oil and 30 barrels water from Dakota "J" sand, Upper Cretaceous 6304-12 and 6322-26 feet, 38-gravity, completed 12-1-54, TD 6370.

NEBRASKA—OIL FIELD EXTENSIONS

Banner County, Unnamed field. Douglas Jones' W. W. Downer 1, C NW SW 12-18n-56w, ½ mile southeast extension, pumped 12 barrels oil and 48 barrels water from Dakota "J" sand, Upper Cretaceous 6231-39 feet, completed 12-1-54, TD 6272.

Kimball County, Sloss State field. Stanolind's W. W. Harboldscheimer 1, C SW SW 25-14n-55w, pumped 168 barrels from Dakota "J" sand, Upper Cretaceous 6228-44 feet, completed 12-31-54, TD 6312.

Swearingen field. Nebraska Drillers, Inc.'s Swearingen 2, SW SW NE 15-14n-55w, ½-mile west extension, pumped 200 barrels from Dakota "J" sand, Upper Cretaceous 6293-6303 and 6314-19 feet, completed 12-29-54, TD 6331.

Voss field. New Drilling Co. & C. M. Coats' Voss 3, SW NE NW 6-13n-53w, pumped 20 barrels oil and 40 barrels water from Dakota "D" sand, Upper Cretaceous 5693-5701 feet, completed 8-3-54, TD 5775.

NEW MEXICO—NEW OIL FIELDS

Chaves County. Joseph I. O'Neill, Jr.'s M. H. Medlin 1-A, in 8-15s-31e, flowed 461 barrels from Queen sand, Permian 3115-32 feet, 20/64-inch, 36-gravity, completed 11-15-54, TD 3132.

Lea County. Carper Drilling Co.'s Sivley 1, in 13-18s-33e, flowed 60 barrels from Queen sand, Permian 4387-4405 feet, open, 36-gravity, completed 12-5-54, TD 4405.

NEW MEXICO—NEW GAS FIELDS

Rio Arriba County. Continental's Jicarilla 2, SW SE NW 20-25n-4w, flowed 3.2 million from Pictured Cliffs sand, Upper Cretaceous 3348-95 feet, open, completed 12-8-54, TD 3395.

San Juan County. Aztec Oil & Gas Co.'s Cain 4, NW SE SW 31-29n-9w, flowed 2.2 million from Pictured Cliffs sand, Upper Cretaceous 2106-59 feet, open, completed 12-4-54, TD 2159.

Unnamed field. El Paso Natural Gas Co.'s Kelly 1, NW SE NE 35-30n-10w, Old Well Worked Over, flowed 2.2 million from Pictured Cliffs sand, Upper Cretaceous 2584-2650 feet, open, completed 12-21-54, TD 4915.

NEW MEXICO—NEW DISTILLATE PAY

Eddy County, Premier field. Great Western Drilling Co.'s Grayburg 1, in 18-

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STATEMENT OF CONDITION

At the Close of Business December 31, 1954

ASSETS

Cash on Hand and Due from Banks		$262,079,705.52
United States Government Obligations	$154,487,411.34	
Public Housing Authority Obligations (Fully Guaranteed)	6,286,906.93	
State, County and Municipal Bonds	19,935,352.63	180,709,670.90
Stock in Federal Reserve Bank		1,200,000.00
Other Bonds		1,713,689.00
Commodity Credit Corporation Certificates and Notes		27,862,928.91
Loans and Discounts		310,344,360.56
Income Accrued		1,928,934.65
Letters of Credit and Acceptances		9,147,341.01
Banking House and Equipment		7,775,308.09
Other Assets		111,423.84
		$802,873,362.48

LIABILITIES

Capital Stock	$ 20,000,000.00	
Surplus Fund	20,000,000.00	
Undivided Profits	8,147,607.33	$ 48,147,607.33
Reserved for Contingencies		3,906,172.02
Reserved for Taxes, Etc.		4,589,826.20
Deferred Income		1,189,844.62
Letters of Credit and Acceptances		9,147,341.01
DEPOSITS:		
Individual	$456,749,860.22	
Banks	264,792,542.36	
U. S. Government	14,350,168.72	735,892,571.30
		$802,873,362.48

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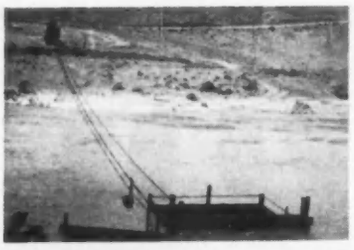
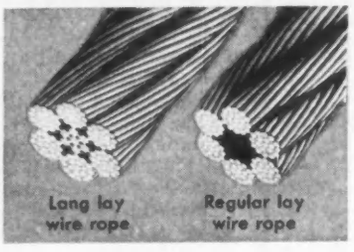




What extra good will Leschen Lang lay wire rope do for you?

Look at a length of Lang lay wire rope. Compare it with regular lay. Notice that the *wires* in Lang lay rope twist in the *same* direction as the *strands*. In regular lay rope these directions are opposite.

What does that do? It makes the exposed length of the outer wires in Lang lay rope about twice as long as in regular lay rope. It has extra bearing surface to withstand wear from scuffing, rubbing and other abrasive action. Also, because Lang lay wires and strands are laid in the same direction, the rope has greater flexibility.

What's the result? Simply this—on some types of duty, where abrasive and bending stresses are abnormal, Leschen Lang lay rope definitely lasts longer than regular lay. Replacements are fewer. Costs are lower. And, with Leschen you are assured of *higher-than-rated quality* for *longer-than-expected wire rope service.*

Can you use these benefits? To make sure, ask your Leschen man. Leschen makes all types of Red-Strand wire rope for all types of jobs, and can help select the best one for you. Perhaps you *should* use Lang lay. Talk to him soon.

Depend on Leschen's higher-than-rated quality for longer-than-expected service.

LESCHEN WIRE ROPE

LESCHEN WIRE ROPE DIVISION
The Watson-Stillman Company
(A SUBSIDIARY OF H. K. PORTER COMPANY, INC.)
St. Louis 12, Missouri

DIVISION OF H. K. PORTER COMPANY, INC. HKP

17s-30e, flowed 287 barrels distillate and 7.0 million from Atoka sand, Pennsylvanian 11,067-95 feet, open, 47.9-gravity, completed 10-20-54, TD 12,211.

NEW MEXICO—OIL FIELD EXTENSIONS

Chaves County, Drickey Queen field. L. B. Hodges' State 1, in 35-13s-31e, 1-mile north extension, flowed 120 barrels from Queen sand, Permian 3054-60 feet, open, 37-gravity, completed 12-4-54, TD 3060.

Lea County, Vacuum field. Texas Gulf Producing Co.'s State 1-E, in 36-17s-33e, 1-mile west extension, flowed 236 barrels from San Andres lime, Permian 4625-4726 feet, ¾-inch, 47-gravity, completed 11-25-54, TD 4726.

NEW MEXICO—GAS FIELD EXTENSIONS

Rio Arriba County, Blanco field. El Paso Natural Gas Co.'s San Juan 27-5 Unit 8, SE NW SW 32-27n-5w, 1-mile south extension, flowed 3.0 million from Mesaverde sand, Upper Cretaceous 4800-5525 feet, open, completed 12-27-54, TD 5525.

Blanco field. Stanolind's Jicarilla 3, NW SE NW 32-26n-5w, 1-mile southeast extension, flowed 13.0 million from Pictured Cliffs sand, Upper Cretaceous 2891-2941 feet, open, completed 12-17-54, TD 2941.

San Juan County, Blanco field. J. Glenn Turner's Ballard 2-12, NE SW SW 12-26n-9w, 1-mile east extension, flowed 0.8 million from Pictured Cliffs sand, Upper Cretaceous 2035-2123 feet, open, completed 12-27-54, TD 2123.

Blanco field. Stanolind's Huerfano 35, SW NE NE 21-26n-9w, 1-mile south extension, flowed 1.1 million from Pictured Cliffs sand, Upper Cretaceous 1977-2023 feet, open, completed 12-24-54, TD 2023.

Blanco field. Stanolind's Huerfano 36, SE NW NW 23-26n-9w, 1-mile southeast extension, flowed 4.9 million from Pictured Cliffs sand, Upper Cretaceous 2034-85 feet, open, completed 12-17-54, TD 2085.

NORTH DAKOTA—OIL FIELD EXTENSION

Bottineau County, Landa Northeast field. Cardinal Drilling Co.'s Wm. Steen 1, C SE NE 31-164n-78w, ¾-mile east extension, pumped 50 barrels from Mission Canyon sand, Mississippian 3051-61 feet, completed 12-10-54, TD 3061.

OKLAHOMA—NEW OIL FIELDS

Carter County. Carter Oil Co.'s Markland-Goddard 1, SW SE NW 20-4s-1w, pumped 125 barrels from Fusilinid & Tussy sands, Pennsylvanian 6330-7568 feet, 32-gravity, TD 9870.

Creek County. Morton & Perrault's Juedman 1, SE SE SW 25-14n-10e, Old Well Worked Over, pumped 2 barrels from Dutcher sand, Pennsylvanian 2686-2702 feet, 31-gravity, TD 3358.

Grady County. Sinclair's W. F. McClintock 1, NE SW SE 8-5n-5w, flowed 308 barrels from Springer sand, Pennsylvanian 11,717-785 feet, ¼-inch, TD 12,395.

Hughes County. Thomas E. Williams' Dalton 1, SW NW SE 4-7n-10e, Old Well Worked Over, flowed 20 barrels from Booch sand, Pennsylvanian 2505-40 feet, TD 3597.

Unnamed field. Webco Drilling Co.'s Yeats 1, SW NE SW 2-6n-8e, pumped 35 barrels from Booch sand, Pennsylvanian 2720-30 feet, TD 2730.

Lincoln County. Northern Oil Co.'s Barney 1, NW NW SW 12-14n-2e, flowed 45 barrels from Checkerboard sand,

Another important Shaffer advancement-

THE SHAFFER Oil-Sealed JAR SAFETY JOINT

After a long period of field-testing and development, Shaffer brings you another important oil tool advancement . . . *a Jar Safety Joint in which all operating parts are sealed in oil—permanently protected against mud, sand and corrosion!* Here are the highlights on what it is and how it works . . .

The Shaffer Oil-Sealed Jar Safety Joint offers all the "two-tools-in-one" features—and the many other advantages of the original Jar Safety Joint first developed by Shaffer years ago. It can be used in testing, fishing, diamond coring or other operations to deliver a sharp upward blow for freeing the string whenever it becomes stuck . . . and, as a Safety Joint, can be readily released in the event the string cannot be loosened.

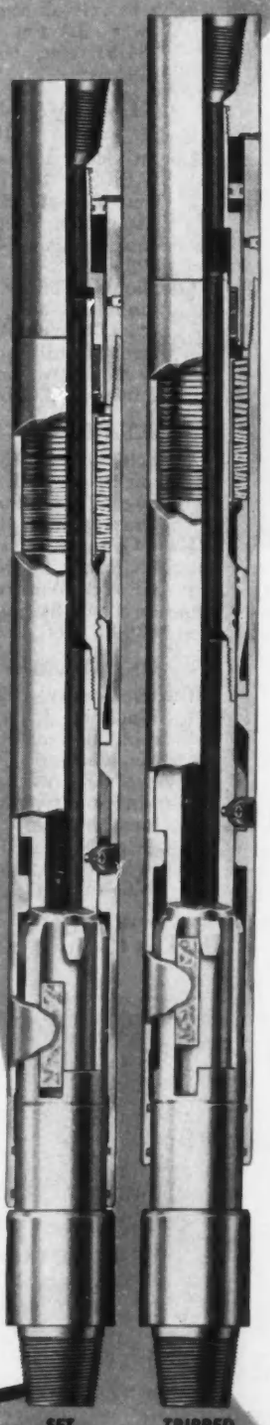
Both these operations—Jarring and Releasing—are performed under the positive control of the operator, and either action can be selected at his discretion.

MECHANISM COMPLETELY OIL-SEALED

To protect the mechanism against the corrosive and abrasive actions of mud, sand and grit, all operating parts are now sealed in a chamber filled with clean oil. At even the greatest depths and highest fluid pressures, this oil-filled chamber prevents the drilling mud from contacting the internal mechanism of the Jar Safety Joint because the oil in the chamber automatically "balances" the varying hydraulic pressures in the well so that packing units are not subjected to excessive pressure differentials.

Result . . .

1. There is no change in "tonnage trip-off" or other characteristics as operating depths increase.
2. Abrasive mud, sand and grit—corrosive chemicals and salts—never contact the operating mechanism. This assures longer life, negligible maintenance.
3. The packing, not being subjected to excessive pressure differentials, lasts much longer and remains leak-proof at even great depths.



SET POSITION — TRIPPED POSITION

Other important advantages

In addition to its Oil-Sealed design, these advantages are also typical of the Shaffer Oil-Sealed Jar Safety Joint . . .

- Jarring action is automatic and positive. To deliver a sharp upward blow, it is only necessary to raise the string until tension is equal to the pre-set tripping load of the tool, whereupon the blow is struck. Lowering the string again re-sets tool for another blow—and repeated blows can be struck as fast as the string can be raised and lowered.
- Only *straight pull* is necessary to operate the tool. No torque or other secondary operations are needed—particularly important on fishing, testing and similar strings where light connections are used.
- The force of the blow is absorbed by integral knocker heads built into the tool—not by easily-damaged drive-keys or threaded elements.
- The Shaffer Oil-Sealed Jar Safety Joint does not depend upon friction for its tripping action. Therefore the tool is not subject to variable operating characteristics. Its action is dependable, uniform, fool-proof!
- The Safety Joint portion has important advantages over conventional safety joints. No threads are used in the releasing mechanism—therefore there's no risk of overtightening by torque. Nor is there risk of accidental release by reverse rotation. Yet when simple releasing procedure is followed, *the tool releases with less than ¼ turn at the tool!*

There are many other advantages. Get the full story by sending for booklet at lower left.

Get The Complete Story on this great Shaffer advancement by sending for this 8 page descriptive booklet. It contains cutaway views of the tool showing the oil-sealed construction and explaining how the tool operates without depending upon friction for tripping . . . gives application details for the tool . . . full dimensions of the various tool sizes, together with exploded views of parts, etc. The Shaffer Oil-Sealed Jar Safety Joint is not shown in the Composite Catalog, so send today for your free copy of this informative new booklet. Or see your nearest Shaffer representative for details.

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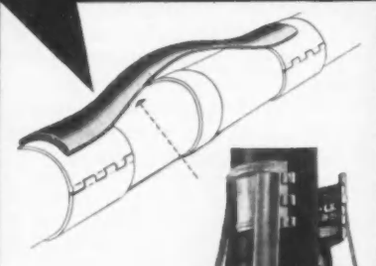

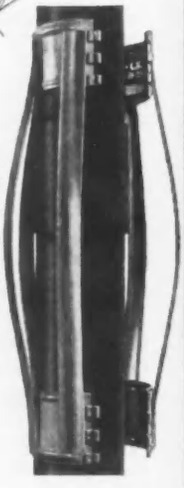

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Pennsylvanian 3542-86 feet, 40/64-inch, 49-gravity, TD 5182.

Logan County. Peppers Refining Co.'s Roleke 1, NW NE SE 14-15n-2w, flowed 60 barrels oil and 215 barrels water from Simpson sand, Ordovician 5882-95 feet, 26/64-inch, TD 6181.

Oklahoma County. C. H. Nicholson's Doster A-1, SE SE SE 28-14n-1e, flowed 35 barrels oil and 3 barrels water from Lower Layton sand, Pennsylvanian 5084-91 feet, ½-inch, 38-gravity, TD 5114.

OKLAHOMA—NEW DISTILLATE FIELDS

Logan County. Powell Briscoe's Heller 1, SW SE SW 31-15n-1e, Old Well Worked Over, flowed 18 barrels distillate and 22.0 million from Checkerboard sand, Pennsylvanian 4420-40 feet, open, TD 5898.

Oklahoma County. Powell Briscoe's M. Reinhart et al 1, SW SW NW 5-14n-10 (1e) Old Well Worked Over, flowed 25 barrels distillate and 15.5 million from Checkerboard sand, Pennsylvanian 4402-12 feet, open, TD 5904.

OKLAHOMA—NEW GAS FIELDS

Garfield County. M & W Drilling Co.'s Bennett 1, NE NE SW 30-20n-3w, flowed 2.0 million from Perry Gas sand, Pennsylvanian 4065-70 feet, TD 5370.

Kay County, Lilystrand, Jr., & Leavel's McCluskey 1, NE NE SW 28-28n-5e, Old Well Worked Over, flowed 0.7 million from Skinner sand, Pennsylvanian 2886-96 feet, 15/64-inch, TD 3062.

OKLAHOMA—NEW OIL PAYS

Carter County, Ardmore, Southwest field. Stanolind's J. Simons 1, NE SE SW 23-5s-1e, flowed 960 barrels from Basal Bromide sand, Ordovician 1394-99 feet, open, 38-gravity, TD 1606.

Garvin County, Foster Northeast. Jake L. Hamon's Ida Raydon 1, C NW NW 24-2n-3w, flowed 396 barrels from Hart sand, Pennsylvanian 7684-7702 feet, 25/64-inch, 47-gravity, TD 7858.

OKLAHOMA—NEW GAS PAY

Texas County, Eva Northwest field. United Carbon Co., Inc.'s F. T. Kelly 10, C NW SW 1-4n-10ecm, flowed 3.4 million from Topeka sand, Pennsylvanian 2930-36 feet, TD 4900.

OKLAHOMA—OIL FIELD EXTENSIONS

Grady County, Bradley field. Phillips' Sterr 1, C NE SW 25-5n-5w, flowed 247 barrels from 1st, 2nd, 3rd, Bromide sands, Ordovician 12,096-440 feet, 10/64-inch, and flowed 125 barrels from McLish & Oil Creek sands, Ordovician 12,540-13,312 feet, 12/64-inch, TD 13,363.

Lincoln County, Mt. Vernon Southwest field. Davidor & Davidor's Howser 1, NE NE SE 28-15n-3e, flowed 216 barrels from Cleveland sand, Pennsylvanian 3496-3515 feet, 16/64-inch, 58-gravity, TD 4441.

Oklahoma County, Edmond field. Powell Briscoe's Anna Moy 1, C SE SW 29-14n-3w, ¾-mile east extension, flowed 240 barrels from Bartlesville sand, Pennsylvanian 6264-86 feet, ¼-inch, TD 6291.

Pawnee County, Mehan, Northeast field. W. C. McBride's Geer 1, SW SE NE 12-18n-3e, 1-mile north extension, pumped 30 barrels oil and 8 barrels water from Cleveland sand, Pennsylvanian 3045-52 feet, TD 3846.

Texas County, Camrick field. Carter's Littau-Flower Unit 1, SW SW NE 25-1n-19ecm, 1-mile southeast extension, pumped 168 barrels from Morrow sand, Pennsylvanian 6963-77 feet, 41-gravity, TD 7027.

Texas County, Keyes field. Shell's State of Okla. Unit "B" 1, NE NE SW 30-6n-10ecm, 2-miles east extension, flowed 166 barrels oil and 55 barrels water from Keyes sand, Pennsylvanian 4601-42 feet, ½-inch, 24.5-gravity, TD 4748.

OKLAHOMA—DISTILLATE FIELD EXTENSION

Kingfisher County, Dover Southwest field. Trigg Drilling Co.'s Kate Armstrong Schroeder 1, NE SW SW 22-17n-7w, flowed 2464 barrels distillate and 35.2 million from Hunton lime, Devo-Silurian 8074-88 feet, open, TD 8088.

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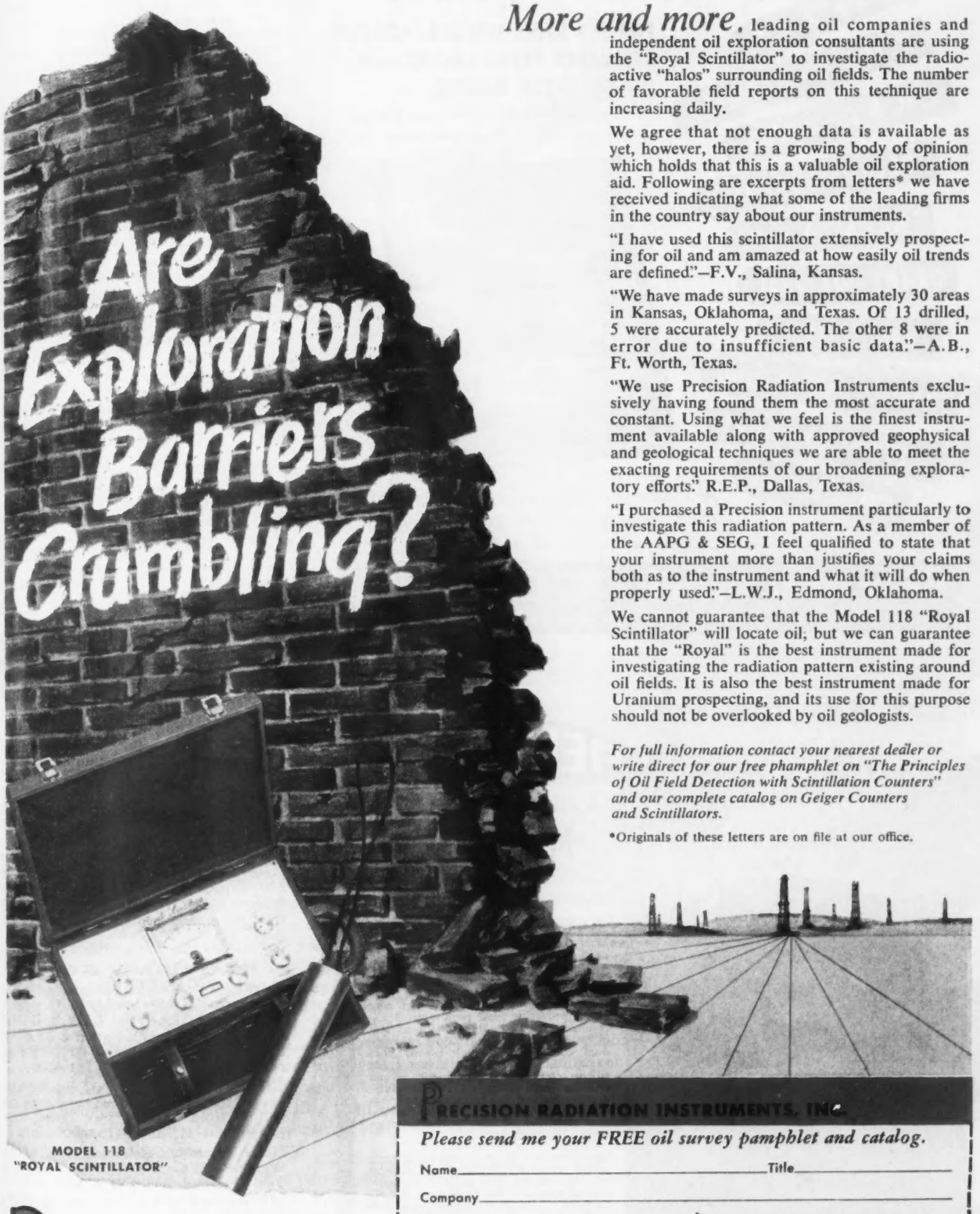

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We cannot guarantee that the Model 118 "Royal Scintillator" will locate oil, but we can guarantee that the "Royal" is the best instrument made for investigating the radiation pattern existing around oil fields. It is also the best instrument made for Uranium prospecting, and its use for this purpose should not be overlooked by oil geologists.

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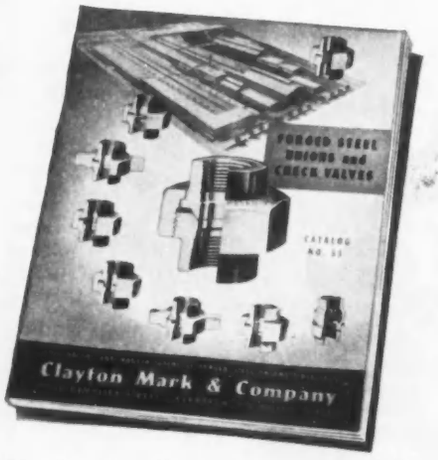

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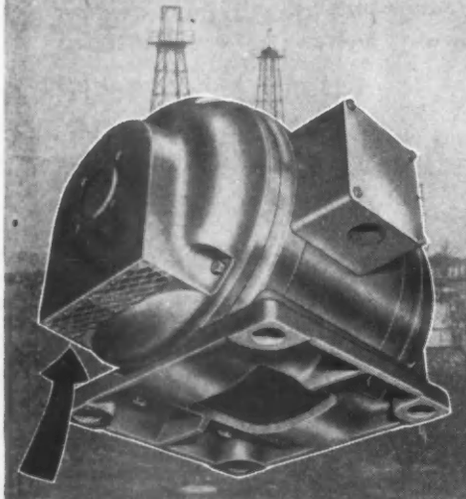

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OKLAHOMA—GAS FIELD EXTENSION

Lincoln County, Midlothian, Northwest field. Anderson Oil Ltd.'s Truax 1, C NW 25-14n-3e, flowed 8.5 million from Skinner sand, Pennsylvanian 4248-64 feet, ½-inch. TD 4697.

PENNSYLVANIA—GAS FIELD EXTENSION

Indiana County. Keta O & G. Co. & Columbia Carbon Co.'s Farmers & Miners Trust Co. 1802, Banks Township, flowed 0.4 million from Oriskany sand, Devonian 7564-7600 feet, TD 7600.

TEXAS DISTRICT 1—NEW OIL FIELDS

Atascosa County, South Crown area. Rodney Delange et al's John A. Wilson 1, Jas. Barclay Survey, flowed 105 barrels from Navarro sand, Upper Cretaceous 4294-4313 feet, 8/64-inch, 40.6-gravity, completed 12-18-54, TD 4352.

Guadalupe County, "Webb" field. H & H Development Co.'s Max Webb 1, Benj. Fuqua Survey, flowed 444 barrels from Austin chalk, Upper Cretaceous 2554-90 feet, ¼-inch, 37-gravity, completed 12-25-54, TD 2770.

TEXAS DISTRICT 1—NEW OIL PAY

Dimmit County, Wintergarden field. Sutton Drilling Co.'s J. F. Cleveland 1, A. Utz Survey, flowed 76 barrels from Olmos "3" sand, Upper Cretaceous 2536-41 feet, 5/32-inch, 44-gravity, completed 12-10-54, TD 2990.

TEXAS DISTRICT 2—NEW OIL FIELD

Jackson County, "McDaniel" field. Sun's D. B. McDaniel 1, Elisah Burton Survey, flowed 40 barrels from Yegua sand, Eocene 5890-5902 feet, ⅛-inch, 45.2-gravity, completed 11-18-54, TD 10,000.

TEXAS DISTRICT 2—NEW DISTILLATE FIELDS

De Witt County. D. D. Feldman O & G et al's N. W. Gohlke 1, J. Tinsley Survey, flowed 350 barrels distillate and 15.0 million from Upper Wilcox sand, Eocene 7324-25 feet, open, 70-gravity, completed 12-15-54, TD 7707.

Unnamed field. Kirkwood & Co.'s Felix Koenig 1, Charles Linn Survey, flowed 100 barrels distillate and 5.0 million from Wilcox "A" sand, Eocene 8746-68 feet, open, 58.1-gravity, completed 12-3-54, TD 9015.

TEXAS DISTRICT 2—NEW GAS FIELDS

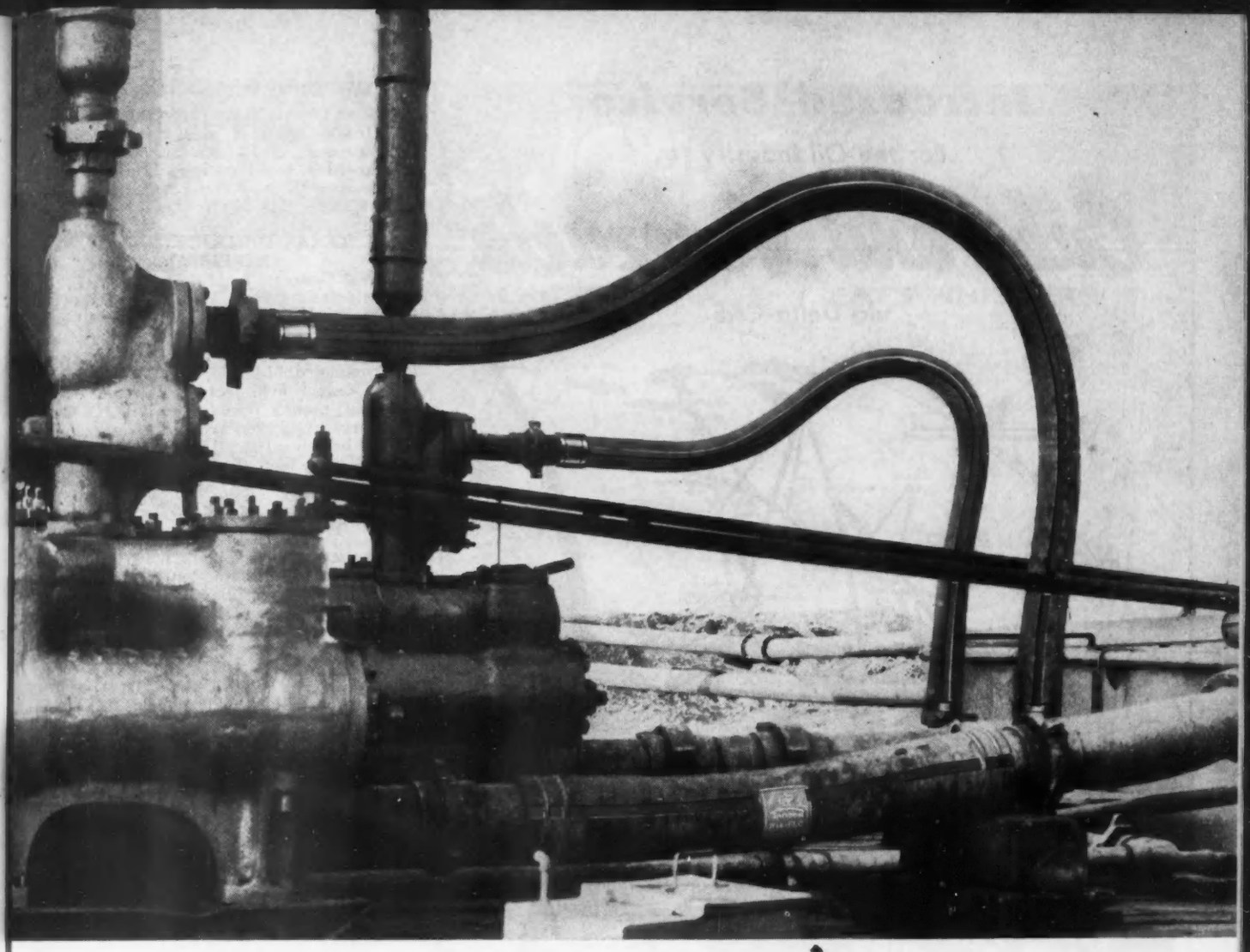
Bee County, "Malone" field. H. C. Spoor, Jr.'s Mary Malone et al 1, Thos. B. Malone (BS&F Survey), flowed 2.2 million from Pettus sand, Eocene 3022-25 feet, open, completed 12-4-54, TD 4000.

Unnamed field. Humble's John R. Carpenter 1, R. P. Little Survey, flowed 5.4 million from 9114-28 feet, open, completed 12-1-54, TD 9475.

Victoria County, "Cologne West" field. Wymore Oil Co.'s Etta Terrell 1, Peter Teal Survey, flowed 8.5 million from 4138-44 feet, open, completed 12-11-54, TD 5073.

TEXAS DISTRICT 2—NEW OIL PAY

Goliad County, Riverdale field. H. R. Smith's R. F. Irby Unit 1, Maria de Jesus Y'Barro Survey, flowed 335 barrels from Wilcox "2nd Massive" sand, Eocene 9273-9318 feet, ⅛-inch, 25.3-gravity, completed 10-1-54, TD 9317.



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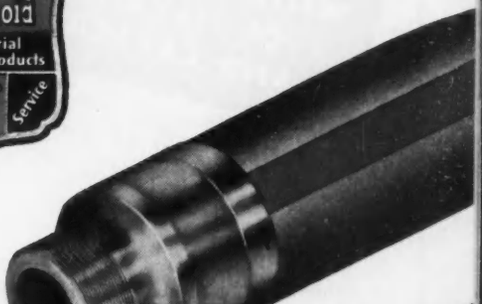

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Mud-Flo Suction Hose

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TEXAS DISTRICT 2—NEW GAS PAY

Jackson County, John Coffee field. Holmes Drilling Co. & J. B. Coffee's Fern Lorenzen 2, J. J. Linn Survey, Block 1, flowed 37.5 million from Frio sand, Oligocene 5823-27 feet, open, completed 11-30-54, TD 5837.

TEXAS DISTRICT 3—NEW OIL FIELDS

Harris County. J. M. Glaintz & R. B. Mitchell's Marie Wise 1, Section 11, Block 1, WCRR Survey, flowed 40 barrels oil and 120 barrels water from 7315-25 feet, 12/64-inch, 43-gravity, completed 11-27-54, TD 8225.

"Crosby" field. John W. Anderson & E. J. Stone's John Sodek 1, D. D. Culp Survey, Old Well Worked Over, pumped 15 barrels oil and 15 barrels water from 8142-52 feet, 34.9-gravity, completed 11-22-54, TD 9147.

TEXAS DISTRICT 3—NEW DISTILLATE FIELD

Fort Bend County. Sam E. Wilson, Jr.'s Harris 1, John Randon Survey, flowed 215 barrels distillate and 13.5 million from 8388-98 feet, open, 55-gravity, completed 12-14-54, TD 8617.

TEXAS DISTRICT 3—NEW OIL PAYS

Galveston County, Algoa field. Superior's Cooper A-1, I&GN RR Survey 13, flowed 145 barrels from Algoa No. 34 sand, Oligocene 9538-41 feet, 7/64-inch, 34.6-gravity, completed 11-28-54, TD 12,415.

Hardin County, Hampton field. Meredith & Co. et al's Lom Hooks 1, Alexander Hampton League ½-mile northeast extension, flowed 116 barrels from Yegua Y-1 sand, Eocene 7676-87 feet, 7/64-inch, 42.3-gravity, completed 12-15-54, TD 8216.

Silsbee, North field. American Republics & Houston Oil's O. C. Nelson Fee 1-V, J. A. Vickers League, flowed 122 barrels oil and 23 barrels water from Yegua No. 3 sand, Eocene 6897-6900 feet, 9/64-inch, 41.1-gravity, completed 12-15-54, TD 7704.

Harris County, Humble field. Traders Oil Co.'s Bender "River" 9, R. Dunman Survey, flowed 157 barrels from Basal Yegua sand, Oligocene 4632-4711 feet, 12/64-inch, 32.2-gravity, completed 12-16-54, TD 4767.

Tomball, West field. H. E. Williams & Texas Pacific Coal & Oil Co.'s Lillie Treseler 1, M. Tejerino Survey, flowed 164 barrels from Cockfield sand, Eocene 5533-35 feet, 9/64-inch, 40.7-gravity, completed 12-9-54, TD 5666.

Liberty County, Merchant field. John W. Mecom, et al's Carrie Mae Champagne et al 1, H&TC RR Survey, Section 193, flowed 223 barrels from Yegua EY-B sand, Eocene 9150-74 feet, 11/64-inch, 31.5-gravity, completed 12-12-54, TD 9662.

Pelican field. Oil & Gas Property Management's B. E. Quinn 1-D, Daniel Doncho Survey Old Well Worked Over, flowed 62 barrels from Wilcox-Quinn sand, Eocene 8804-49 feet, 7/64-inch, 35-gravity, completed 12-11-54, TD 8851.

TEXAS DISTRICT 3—NEW DISTILLATE PAYS

Chambers County, South Mayes field. McCarthy O&G Corp.'s Mrs. Annie Frankland et al 2, Samuel Mather Survey 12, flowed 145 barrels distillate and 1.6 million from Frio No. 15 sand, Oligocene 11,-718-40 feet, 8/64-inch, 51.3-gravity, completed 12-2-54, TD 11,995.

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Colorado County, Cecil Noble field. C. N. Housh & American Republics' Papenberg 1, E. Tumlinson Survey, flowed 47 barrels distillate and 1.0 million from Papenberg sand, Eocene 8927-36 feet, open, 51-gravity, completed 10-30-54, TD 9091.

Harris County, Aldine field. Kilroy Co. Inc.'s Mattie B. Merrill et al 1, S. L. Noble Survey, flowed 66 barrels distillate, and 4.2 million from Yegua sand, Eocene 7940-65 meet, open, 53.4-gravity, completed 12-24-54, TD 8015.

Wharton County, Schmidt field. Caroline Hunt Sands' Agnes Wychopen 1, BBB &C RR Survey, Block 1, flowed 82 barrels distillate and 16.5 million from Frio sand, Oligocene 5944-48 feet, open, completed 12-6-54, TD 6200.

TEXAS DISTRICT 3—DISTILLATE FIELD EXTENSIONS

Fort Bend County, Fulshear field. Billy Bridewell & R. H. Hedge's Mrs. Rosalie C. Meek 1, Stephen Hobermaker Survey, ⅔-mile southeast extension, flowed 420 barrels distillate and 29.0 million from Cockfield sand, Eocene 6938-42 feet, open, 62-gravity, completed 9-19-54, TD 8012.

Wharton County, West Bernard field. BBM Drilling Co.'s Winterman-Hudgins 1, Section 16, A. Swartz Survey, ½-mile northwest extension, flowed 140 barrels distillate and 9.7 million from Yegua (DY) sand, Eocene 6719-25 feet, open, 53.8-gravity, and 265 barrels distillate and 17.6 million from Hudgins sand, Eocene 6975-82 feet, open, 64-gravity, completed 11-15-54, TD 7662.

TEXAS DISTRICT 4—NEW OIL FIELDS

Aransas County. C. G. Glasscock Oil Co.'s State Tract 22, flowed 89 barrels from Frio (A-2) sand, Oligocene 6770-82 feet, 9/64-inch, 44-gravity, completed 12-8-54, TD 6951.

Jim Wells County, "Mary Davidson" field. S. H. Howell's Mary Davidson 1, Jno M. C. Nixon ½ Geo. W. Morgon Survey, Old Well Worked Over, flowed 138 barrels from Hockley sand, Eocene 4754-62 feet, 8/64-inch, 41.5-gravity, completed 12-24-54, TD 5521.

TEXAS DISTRICT 4—NEW DISTILLATE FIELD

San Patricio County. Lonnie Glasscock's Lewis Weir 1, San Patricio de Hibernia Town Tract, ungaged from Frio sand, Oligocene 5832-36 feet, completed 11-15-54, TD 6575.

TEXAS DISTRICT 4—NEW OIL PAYS

Aransas County, Aransas, East field. Atlantic's Mary S. Heist 1, Jas. McKay Survey, Block 229, flowed 160 barrels from Frio C-1 sand, Oligocene 7364-74 feet, ¼-inch, 38.2-gravity, completed 12-11-54, TD 8800.

Brooks County, Mills Bennett field. Mills Bennett Estate's Fee 13, Ysidora Guerra Palo Blanco Grant, flowed 88 barrels from Frio "B" sand, Oligocene 3992-4000 feet, X-29-inch, 42-gravity, completed 12-18-54, TD 6084.

Kenedy County, Barreta field. Humble's Mrs. S. K. East E-1, "Los Finados" Grant, flowed 65 barrels from 7180-92 feet, ⅛-inch, 41.3-gravity, completed 12-30-54, TD 10,507.

Starr County, Cameron field. W. U. Paul's Helene W. Lyons et al 2, CB&CNG Survey, Section 225, flowed 83 barrels from Frio sand, Oligocene 4230-36 feet, 8/64-inch, 45.1-gravity, completed 12-29-54, TD 4833.

TEXAS DISTRICT 4—NEW DISTILLATE PAYS

Hidalgo County, South McAllen field. Taylor O&G Co. & Mayfair Minerals Inc.'s Katie Sherrill et al 1, Hidalgo Canal Co. Subd., flowed 100 barrels distillate and 11.0 million from Frio sand, Oligocene 6776-90 feet, open, 56.8-gravity, completed 12-18-54, TD 7602.

Tabasco field. Houston Oil & American Republics' Hidalgo Willacy Oil Co. et al 1, Los Ejidos de Reynosa Viejo Grant, flowed 189 barrels distillate and 3.2 million from 7583-98 and 7618-34 feet, open, 56.6-gravity, completed 12-6-54, TD 10,533.

Jim Wells County, Almond field. Associated O&G Co.'s W. F. Almond A-2, HT&B Survey, Section 7, flowed ungaged from Stillwell sand, Oligocene 5255-65 feet, completed 10-5-54, TD 5324.

TEXAS DISTRICT 4—NEW GAS PAY

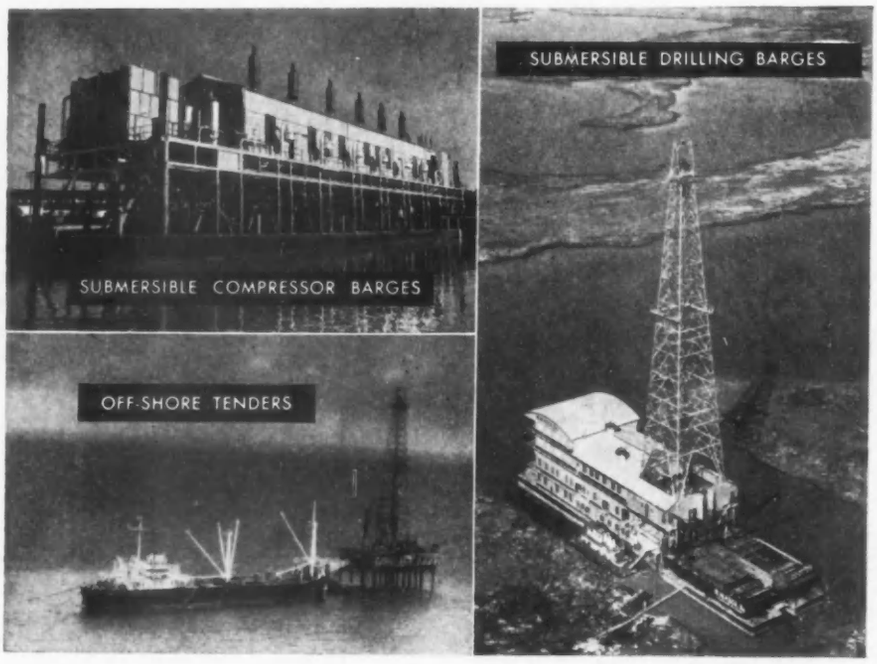
Nueces County, Minnie Bock, West field. Edwin L. Cox's John Davis Estate 1, George H. Paul Subdivision, Section 63, flowed 1.2 million from Frio "C" sand, Oligocene 5826-34 feet, open, completed 5-17-54, TD 5962.

TEXAS DISTRICT 6—NEW OIL FIELD

Gregg County. F. R. Jackson & John C. Robbins' O. H. Grissom 1, Dinsmore-Simpson Survey, flowed 120 barrels from Pettit lime, Lower Cretaceous 7060-80 feet, ¼-inch, 45-gravity, completed 12-6-54, TD 7212.

TEXAS DISTRICT 6—NEW OIL PAYS

Franklin County, Cornersville field. Hum-



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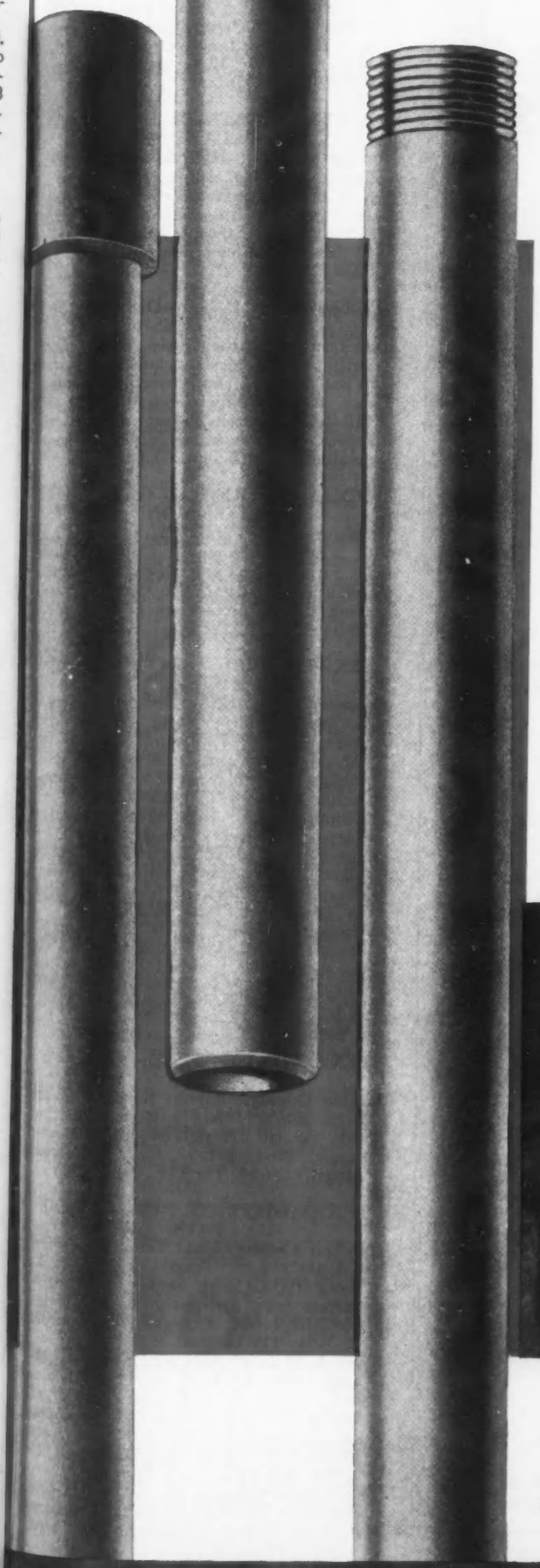

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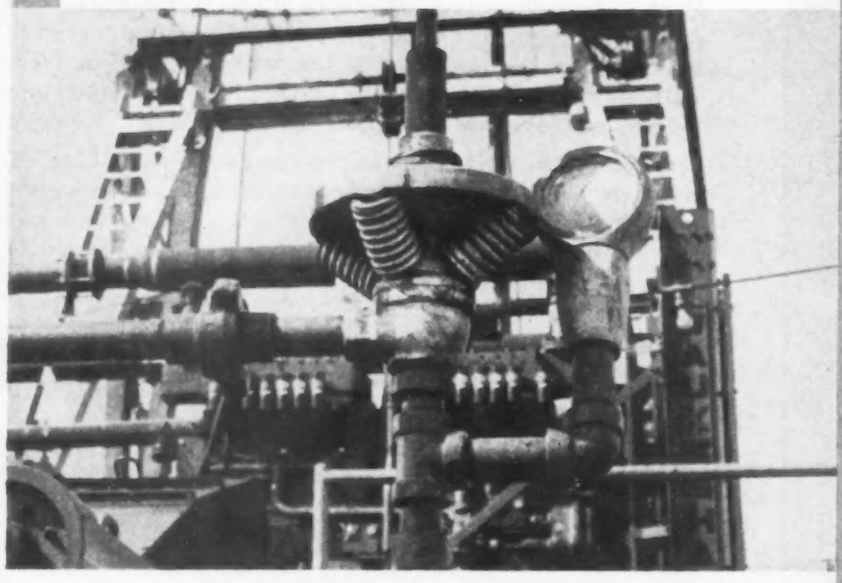

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ble's A. C. Ballard et al 1, J. C. Elder Survey, Old Well Drilled Deeper, pumped 27 barrels from Pittsburg sand, Lower Cretaceous 8232-46 feet, 43-gravity, completed 12-22-54, TD 4667.

Rusk County, Minden field. Natural Gas & Oil Corp.'s E. C. Cates & C. N. Rogers 1, Fred Blanchard Survey, Old Well Worked Over, flowed 168 barrels from Hill sand, Lower Cretaceous 6377-80 feet, ⅛-inch, 39.4-gravity, completed 12-12-54, TD 7700.

TEXAS DISTRICT 6—NEW DISTILLATE PAY

Harrison County, Hallsville, South field. Latex O&G Co., Inc.'s H. E. Gisler 2, J. B. Barton Survey, flowed 69 barrels distillate and 5.1 million from Pettit (Page) sand, Lower Cretaceous 6536-43 feet, open, completed 12-6-54, TD 6580.

TEXAS DISTRICT 6—DISTILLATE FIELD EXTENSION

Rusk County, Carthage field. Carter-Jones Drilling Co.'s M. E. Adams 1, Thomas O'Bar Survey, 1-mile northwest extension, flowed 4060 barrels distillate and 116.0 million from Pettit (Crane) sand, Lower Cretaceous 6817-23 feet, open, completed 12-18-54. TD 6864.

TEXAS DISTRICT 6—GAS FIELD EXTENSION

Harrison County, Hallsville South field. J. C. Trahan's Brown & Cullen 1, John D. Pinson Survey 1, ¾-mile northwest extension, ungaged from Pettitt (Crane) sand, Lower Cretaceous, completed 10-15-54, TD 7100.

TEXAS DISTRICT 7-C—NEW OIL FIELDS

Runnels County. G. W. Strake's Rogers 3, E. Mather Survey, Old Well Worked Over, pumped 73 barrels oil and 162 barrels water from Goen lime, Pennsylvanian 3873-78 feet, 37.9-gravity, completed 11-23-54, TD 4136.

Unnamed field. Sojourner Drilling Corp.'s J. C. Byers 1, Austin & Williams Survey, flowed 105 barrels oil and 26 barrels water from Jennings sand, Permian 3664-72 feet, 20/64-inch, 40-gravity, completed 11-20-54, TD 4006.

Unnamed field. T. D. Humphrey & Sons, Ltd's W. A. Ashton 1, J. H. Wilson survey 160, pumped 21 barrels from Serratt sand, Pennsylvanian 2329-36 feet, 36.4-gravity, completed 11-6-54, TD 2522.

TEXAS DISTRICT 7-C—NEW GAS FIELD

Kimble County. Barron Kidd & Cherry Bros.' Stella McKee 1, R. S. Beard Survey, flowed 0.9 million from Pennsylvanian sand, 846-52 feet, open, completed 7-20-54, TD 874.

TEXAS DISTRICT 7-C—NEW OIL PAYS

Crockett County, Todd field. Val-Carroll Oil Co.'s J. S. Todd C-1, Section 15, Block 10, GC&SF Survey, pumped 30 barrels from Grayburg sand, Permian 1580-1619 feet, 32.6-gravity, completed 12-1-54, TD 1619.

Runnels County, Ami-Jennings field. Miama Operation Co.'s H. F. Lindemann A-1, Austin & Williams Survey 262, flowed 86 barrels from Upper Gardner sand, Pennsylvanian 3794-3801 feet, 24/64-inch, 41-gravity, completed 12-10-54, TD 4140.

Tom Green County, H. J. Strawn field. Humble's Joe Funk 6, Section 16, Mary E. Ratcliff Survey, pumped 26 barrels

oil and 56 barrels water from Lower Strawn lime, Pennsylvanian 6122-28 feet, 2⅜-inch, 35.9-gravity, completed 11-22-54, TD 7071.

Upton County, Texel field. Gulf's McElroy Ranch Co. 3-H, Section 38, Block 42, T-5-S, T&P Survey, flowed 261 barrels from Pennsylvanian sand, 9143-9195, 12/64-inch, 45.6-gravity, completed 11-19-54, TD 12,505.

TEXAS DISTRICT 7-C—OIL FIELD EXTENSION

Runnels County, Ballinger field. Gilchrist Drilling's Hugh Campbell 1, Joseph Bays Survey 530, 1-mile southwest extension, flowed 92 barrels from Palo Pinto lime, Pennsylvanian 3451-55 feet, 12/64-inch, 41-gravity, completed 11-29-54, TD 3518.

TEXAS DISTRICT 8—NEW OIL FIELDS

Crane County "Waddell Block B-21" field. Gulf's W. N. Waddell 221, Section 17, Block B-21, PSL Survey, flowed 894 barrels from Waddell sand, Ordovician 6030-85 feet, ½-inch, 36.6-gravity, completed 11-24-54, TD 6408.

Unnamed field. Atlantic's Everett & Glass 36-1, Section 36, Block 43, T-4-S, T&P Survey, flowed 104 barrels from Pennsylvanian lime, 9042-9112 feet, 22/64-inch, 40-gravity, completed 11-25-54, TD 12,690.

Unnamed field. Shell's University 1-30-A, Section 25, Block 30, Univ. Lds. Survey, flowed 311 barrels oil and 13 barrels water from San Andres lime, Permian 3520-12,158 feet, ½-inch, 32-1-gravity, completed 11-27-54, TD 12,158.

Ector County, "Goldsmith West" field. Cities Production Corp. et al's TXL O-1, Section 21, Block 45, T-1-N, T&P Survey, flowed 1575 barrels from Fusselman lime, Silurian 8294-8326 feet, ¾-inch, 39-gravity, completed 11-30-54, and flowed 1118 barrels from Ellenburger lime, Ordovician 9428-9509 feet, ¾-inch, 44-gravity, completed 12-1-54, TD 9509.

Unnamed field. The Texas Co.'s Texas-Magnolia-Sallie W. Ratliff 1, Section 25, Block 42, T-1-S, T&P Survey, flowed 580 barrels from Ellenburger lime, Ordovician 13,560-580 feet, 48/64-inch, 54.5-gravity, completed 11-18-54, TD 13,625.

Gaines County, Honolulu Oil's Mrs. C. H. Wescott et al 1, Section 2, Block C-44, PSL Survey, flowed 1168 barrels from Pennsylvanian lime, 10,980-11,008 feet, 11/32-inch, 47-gravity, completed 11-21-54, TD 14,284.

Hockley County. Standard of Texas W. C. Huffacker 1-2, Section 1, Tract 4, Block D, EL&RR Survey, pumped 212 barrels from Clearfork lime, Permian 7126-10,200 feet, 27-gravity, completed 11-27-54, TD 10,200.

Midland County. A. Fasken's Fee 1-14, Section 14, Block 37, T-2-S, J. V. Stokes Survey 1-mile west extension, flowed 83 barrels from Grayburg lime, Permian 3956-3941 feet, ⅜-inch 32-gravity, completed 11-15-54, TD 3962.

Mitchell County. Sid Katz et al's Tom Morrison et al 1, Section 34, Block 29, T-1-N, T&P Survey, pumped 69 barrels oil and 22 barrels water from Clearfork lime, Permian 2648-2730 feet, 28-gravity, completed 11-23-54, TD 3050.

Terry County, Joseph I. O'Neill, Jr. & Sharples' Cacy Day 1, Section 23, Block D-11, C&MRR Survey, pumped 221 barrels from Glorieta lime, permian 5998-6024 feet, 30-gravity, completed 11-9-54, TD 7015.

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Yoakum County. Anderson-Prichard & U. S. Smelting & Husky Oil's P. S. Hanks 1, Section 884, Block D, John H. Gibson Survey, pumped 216 barrels from Wolfcamp lime, Permian 9960-10,010 feet, 31-gravity, completed 12-7-54, TD 13,315.

TEXAS DISTRICT 8—NEW OIL PAYS

Andrews County, Emma field. J. Ray McDermott & Co., Ind.'s University "21578" 1, Section 36, Block 10, University lands, flowed 200 barrels from Devonian lime 10,360-10,438 feet, ⅜-inch, 43.5-gravity, completed 12-20-54, TD 12,521.

Ector County, Andector field. Humble's R. B. Cowden E-1, Section 12, Block 45, T-2-N, T&P Survey, Old Well Worked Over, flowed 316 barrels from Permian lime 5580-95 feet, ¼-inch, 37-gravity, completed 11-15-54, TD 8666.

Yarbrough & Allen field. Humble's Yarbrough & Allen 18, Section 17, Block B-14, PSL Survey, Old Well Worked Over, flowed 191 barrels from Devonian lime, 8430-70 and 8480-8505 feet, 25/64-inch, 37-gravity, completed 11-21-54, TD 10,800.

TEXAS DISTRICT 8—OIL FIELD EXTENSIONS

Andrews County, Shafter Lake field. The Sharples Oil Corp.'s C. H. Park 1, Section 20, Block A-36, PSL Survey 2-mile southeast extension, pumped 63 barrels from San Andres lime, Permian 4340-4595 feet, 32-gravity, completed 11-23-54, TD 4627.

Crane County, Sand Hills-McKnight field. Gulf's M. B. McKnight 25, Section 23, Block B-17, PSL Survey, ¾-mile northwest extension, pumped 63 barrels oil and 39 barrels water from San Andres lime, Permian 3254-3475 feet, 32-gravity, completed 11-25-54, TD 3475.

Yoakum County, Brahaney field. Calton H. Cobb & Tri-Service Drilling Co.'s Carr & Northrup 1, Section 447, Block D. J. H. Gibson Survey, 1-mile southwest extension, flowed 96 barrels from San Andres lime, Permian 5190-5255 feet, 32/64-inch, 33-gravity, completed 11-8-54, TD 5300.

TEXAS DISTRICT 10—NEW GAS FIELDS

Hansford County. Humble's Oil Development Co. of Texas 1, Section 2, Block 4-T, T&NO Survey, flowed 1.5 million from Morrow sand, Mississippian 7650-76 feet, open, completed 12-21-54, TD 9650.

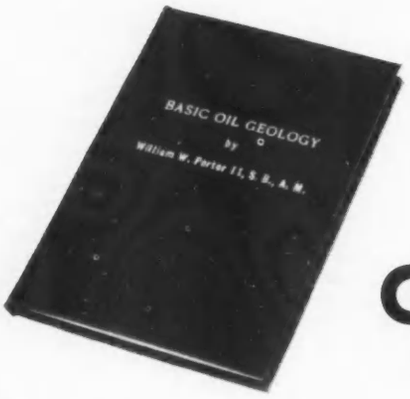
Roberts County. Cree Drilling Co.'s R. L. Flowers-Shell-Flowers 1, Section 75, Block C. G&M Survey, flowed 11.0 million from Brown dolomite, Pennsylvanian 3760-88 feet, open, completed 12-14-54, TD 3860.

WYOMING—NEW OIL FIELD

Natrona County. Forest Oil Co.'s Morton 1, NE SE NW 22-32n-85w, flowed 1220 barrels from Muddy sand, Lower Cretaceous 6723-80 feet, ¼-inch, completed 8-30-54, TD 7288.

WYOMING—NEW GAS FIELD

Sublette County. General Pet. Co.'s Tip Top 73-31, NW SE NE 31-29n-113w, flowed 0.8 million from Frontier sand, Upper Cretaceous 5966-6010 feet, completed 12-6-54, TD 7665.



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Here Are the Questions Most Often Asked About Air and Gas Drilling

WORLD OIL put these questions to experts in the field. Their replies seem to indicate rapid solution of the problems and early industry approval.

By **PHILIP L. McLAUGHLIN,** Drilling Editor, WORLD OIL

Where can air or gas be used?

Q. *Where have air and gas drilling techniques been used? What will the future drilling trends be?*

A. Air and gas drilling techniques have applicability for many areas. The limitations will be discussed later in this report. No nationwide geological appraisal of formations considered ideally suited for air drilling are known to have been made, but it is interesting to note that a high percentage of today's oil producing areas have some application.

Tomorrow's drilling provinces, including the south and western sections of U. S. and portions of Canada, offer a prolific future market.

One major company estimated that more than 20 percent of the total footage in West Texas can be drilled with air. The inevitable solution of water problem, perfection of aerated mud techniques and development of adequate compressor equipment will brighten the outlook.

Air drilling is known to have been done in Canada, California, Utah, Oregon, Wyoming, Colorado, New Mexico, Oklahoma, West, Central and North East Texas, Arkansas, Mississippi, Pennsylvania, and West Virginia.

Compressor market . . .

Q. *Who will need compressed air equipment?*

A. At present there are four general compressor markets. They include:

Oil producing companies which now are using various types of compressors in experimental and in actual field development work. This equipment is usually purchased or rented as outlined below.

Drilling contractors who drill the greatest percentage of today's wells may be asked by an oil company to use compressed air. Equipment may be purchased or rented.

Service companies furnish compressed air and personnel with air-drilling know-how to drill with any standard rig equipment. (See Page 110, January WORLD OIL.) Equipment service is rented to above users.

Compressor rental services are available whereby any of the above users could rent compressors of desired size and type.

Factors to be considered . . .

Q. *What factors favor air drilling?*

A. Factors which favor air drilling are:

Hard Formations. Where time spent in making connections is not an appreciable time of drilling time. Where bit costs are an appreciable part of total drilling cost.

Dry Country. Where water costs may be excessive. Where there are relatively few liquid producing zones.

Cavernous Areas. Where lost circulation might make rotary drilling with mud impossible.

Extremely Cold Climate. Where elaborate precaution would have to be taken against mud freezing.

Low Pressure, Easily Damaged Pay Zones. Such formations as Mesa Verde gas sands and sands in the San Juan Basin of New Mexico are excellent examples of use of air or gas for completions to increase the productivity of the well.

Character of Formations. Formations which exhibit increased drillability, when hydrostatic pressures at bottom of the hole is reduced will favor air drilling.

Q. *What factors oppose air drilling?*

A. Factors which oppose air drilling are:

Soft Formations. Where bit costs are negligible in proportion to total drilling costs. Where time spent making connections is unappreciable percentage of the total drilling time.

Thick, Frequent, Highly Productive Fluid Producing Zones.

Sloughing Formations. Where formation slips when wet.

Unexpected High Pressure Gas Zones.

Volumetric requirements

Deep Wells

Q. *How can the air or gas volumetric requirements for lifting cuttings from deep holes be determined?*

A. The lifting power is directly proportional to the density and to the square of the velocity. Computations given here are made assuming an annular velocity of the fluid at the point of lowest velocity in the annulus equivalent in lifting power to 2000 and 3000 feet per

Whenever the industry considers anything as much in its infancy as air drilling, certain precautions should be observed. Many of the answers in this series of articles are based on projection of limited experience, frequently the experience of one operator. At this time, for example, most operators have been unsuccessful in coping with water. Although they have not had sufficient pressure available to know its benefit, pressure does hold promise for handling low volumes of water. The material presented here is intended to help the industry solve these problems sooner. WORLD OIL would appreciate hearing what you think of the coverage given to this subject in the January and February issues.

TABLE 1

Hole Dia. D_3 Inches	Pipe O.D. D_2 Inches	V = 3000 Ft./Min. ..... C_1 ..... For Various Hole Depths							C_2 For Specific Gravity Shown		
		1000′	2000′	4000′	6000′	8900′	10,000′	12,000′	1.0 Air	.8	.6 Methane
15	6⅝	5.8	4.1	2.9	2.4	2.0	1.83	1.67	181	202	234
	5½	6.3	4.5	3.2	2.6	2.2	2.0	1.82	195	218	251
	4½	6.8	4.8	3.4	2.8	2.4	2.1	1.95	205	229	264
12¼	6⅝	4.4	3.1	2.2	1.81	1.57	1.41	1.28	106	119	137
	5½	5.0	3.6	2.5	2.0	1.78	1.59	1.45	120	134	155
	4½	5.5	3.9	2.8	2.2	1.95	1.74	1.59	130	145	168
11	6⅝	3.8	2.7	1.88	1.54	1.33	1.19	1.09	77	86	100
	5½	4.4	3.1	2.2	1.79	1.55	1.39	1.26	91	101	117
	4½	4.9	3.5	2.4	2.0	1.73	1.55	1.41	101	113	130
9⅞	5½	3.8	2.7	1.88	1.54	1.33	1.19	1.09	67	75	87
	5	4.0	2.9	2.0	1.65	1.43	1.28	1.17	73	81	94
	4½	4.3	3.1	2.2	1.76	1.53	1.37	1.25	77	86	100
9	5	3.5	2.5	1.77	1.45	1.25	1.12	1.02	56	63	72
	4½	3.8	2.7	1.92	1.56	1.35	1.21	1.11	61	68	78
	3½	4.4	3.1	2.2	1.79	1.55	1.39	1.27	69	77	89
8¾	5	3.4	2.4	1.70	1.39	1.20	1.07	.98	52	58	67
	4½	3.7	2.6	1.84	1.51	1.30	1.17	1.06	56	63	73
	3½	4.3	3.0	2.1	1.73	1.50	1.34	1.23	64	72	83
7⅞	4½	3.1	2.2	1.58	1.29	1.12	1.00	.91	42	47	54
	3½	3.8	2.7	1.88	1.54	1.33	1.19	1.09	50	56	64
7⅜	3½	3.5	2.4	1.73	1.41	1.22	1.09	1.00	42	47	54
6¾	3½	3.4	2.2	1.54	1.25	1.09	.97	.89	33	37	43
6¼	3½	2.8	1.9	1.38	1.12	.97	.87	.79	27	30	35
	2⅞	3.2	2.2	1.58	1.29	1.12	1.00	.91	31	34	40
4¾	2⅞	2.1	1.5	1.06	.87	.75	.67	.61	14	16	18
	2⅜	2.5	1.8	1.25	1.02	.88	.79	.72	17	19	22

Courtesy Hughes Tool Co.

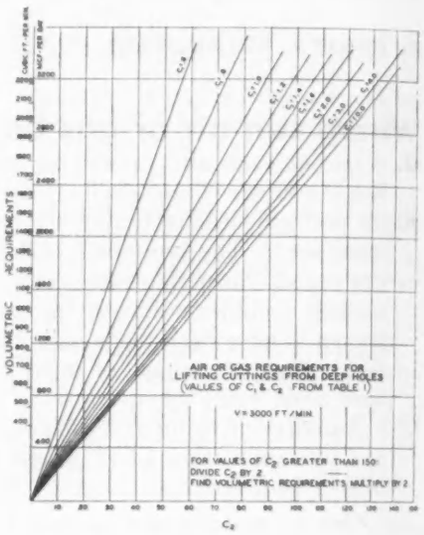

VOLUMETRIC REQUIREMENTS
AIR OR GAS REQUIREMENTS FOR LIFTING CUTTINGS FROM DEEP HOLES (VALUES OF C_1 & C_2 FROM TABLE 1)
V = 3000 FT./MIN.
FOR VALUES OF C_2 GREATER THAN 150: DIVIDE C_2 BY 2. FIND VOLUMETRIC REQUIREMENTS. MULTIPLY BY 2
C_2

FIGURE 1

TABLE 2

Hole Dia. D_3 Inches	Pipe O.D. D_2 Inches	V = 2000 Ft./Min. ..... C_1 ..... For Various Hole Depths							C_2 For Specific Gravity Shown		
		1000′	2000′	4000′	6000′	8000′	10,000′	12,000′	1.0 Air	.8	.6 Methane
15	6⅝	8.7	6.1	4.3	3.6	3.0	2.7	2.5	181	202	234
	5½	9.5	6.7	4.7	3.9	3.3	3.0	2.7	195	218	251
	4½	10.3	7.2	5.1	4.2	3.6	3.2	2.9	205	229	264
12¼	6⅝	6.7	4.7	3.3	2.7	2.4	2.1	1.92	106	119	137
	5½	7.5	5.3	3.8	3.0	2.7	2.4	2.2	120	134	155
	4½	8.3	5.8	4.1	3.3	2.9	2.6	2.4	130	145	168
11	6⅝	5.6	4.0	2.8	2.3	2.0	1.79	1.64	77	86	100
	5½	6.6	4.7	3.3	2.7	2.3	2.1	1.89	91	101	117
	4½	7.3	5.2	3.7	3.0	2.6	2.3	2.1	101	113	130
9⅞	5½	5.6	4.0	2.8	2.3	2.0	1.79	1.64	67	75	87
	5	6.0	4.3	3.0	2.5	2.1	1.92	1.76	73	81	94
	4½	6.5	4.6	3.2	2.6	2.3	2.1	1.88	77	86	100
9	5	5.3	3.8	2.7	2.2	1.88	1.68	1.53	56	63	72
	4½	5.7	4.1	2.9	2.3	2.0	1.82	1.67	61	68	78
	3½	6.6	4.7	3.3	2.7	2.3	2.1	1.91	69	77	89
8¾	5	5.1	3.6	2.6	2.1	1.80	1.61	1.47	52	58	67
	4½	5.5	3.9	2.8	2.3	1.95	1.76	1.59	56	63	73
	3½	6.4	4.5	3.2	2.6	2.6	2.0	1.85	64	72	83
7⅞	4½	4.7	3.3	2.4	1.93	1.67	1.50	1.36	42	47	54
	3½	5.6	4.0	2.8	2.3	2.0	1.79	1.64	50	56	64
7⅜	3½	5.2	3.7	2.6	2.1	1.83	1.64	1.50	42	47	54
6¾	3½	4.6	3.3	2.3	1.88	1.64	1.46	1.34	33	37	43
6¼	3½	4.1	2.9	2.1	1.68	1.46	1.31	1.19	27	30	35
	2⅞	4.7	3.3	2.4	1.94	1.68	1.50	1.37	31	34	40
4¾	2⅞	3.2	2.3	1.59	1.31	1.13	1.00	.92	14	16	18
	2⅜	3.8	2.7	1.88	1.53	1.32	1.19	1.08	17	19	22

Courtesy Hughes Tool Co.

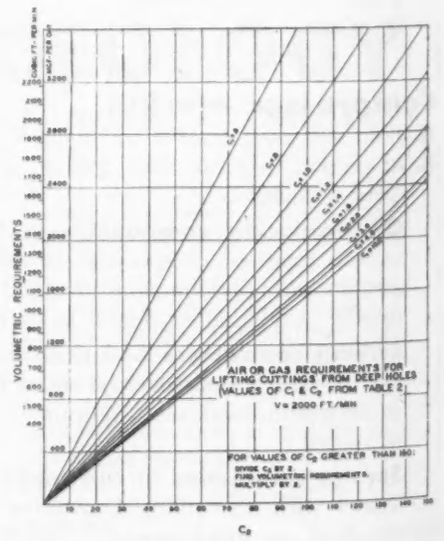

VOLUMETRIC REQUIREMENTS
AIR OR GAS REQUIREMENTS FOR LIFTING CUTTINGS FROM DEEP HOLES (VALUES OF C_1 & C_2 FROM TABLE 2)
V = 2000 FT./MIN.
FOR VALUES OF C_2 GREATER THAN 150:
C_2

FIGURE 2

minute of free air. These velocities have proved satisfactory in field for quarry shot hole and oil well drilling.

For velocity of 3000 feet per minute . . . The derivation from the Weymouth flow formula results in the equation:

$$Q = 23.517 \times \frac{C_2}{C_1}\sqrt{1+\sqrt{1+C_1^4}}$$

in which

Q = volume of free gas (or air) in thousands of cubic feet per day required to lift cuttings.

C_2 = a function of hole size, pipe size and gas specific gravity (based on air = 1.0)

C_1 = a function of annular velocity, pipe size, hole size and depth of well.

Table 1 provides values of C_1 at various hole sizes, pipe sizes, and well depths. Likewise, values of C_2 are shown for the various hole and pipe sizes and specific gravities. Figure 1 is a solution of the above equation with values of C_2 plotted against values of C_1 to obtain the unknown quantity Q.

For velocity of 2000 feet per minute . . . Adequate return of cuttings may be possible with lower velocities in the order of 2000 feet per minute.

For intermediate values of equivalent velocity, volumetric requirements may be determined roughly by interpolation between Tables 1 and 2. The inaccuracy of such estimates increases with smaller values of C_1.

For a 2000 feet per minute velocity, the equation given above becomes:

$$Q = 15.678 \times \frac{C_2}{C_1}\sqrt{1+\sqrt{1+C_1^4}}$$

Table 2 is for obtaining values of C_1 and C_2 and Figure 2 for the graphic solution of the above equation to obtain volumetric requirements.

It should be noted that an increase in pipe size for a given hole size will not necessarily reduce the quantity of gas required to obtain adequate annular return velocities. A decreased annulus causes increased frictional losses and in extreme cases may lower the velocity at bottom to the extent that cuttings are not removed. An optimum pipe size may be considered to exist for any set of conditions.

How To Graphically Solve for Volumes.

EXAMPLE:

Assume a 9⅞-inch hole drilled with 5-inch drill pipe to a depth of 4000 feet using gas (Sp. Gr. = 0.6) as a flushing fluid.

From Table 1, $C_1 = 2.0$ and $C_2 = 94$.

Choosing the point for $C_2 = 94$ on Figure 1, draw a vertical line up to the intersection of $C_1 = 2.0$. From this point a horizontal line over to the vertical volume scale indicates 2490 or 2,490,000 cubic feet per day. Should the volume in cubic feet per minute have been desired, the left hand volume scale provides the figure 1730 cubic feet per minute.

Volumetric requirements for shallow holes . . .

TABLE 3

Volumetric Requirements—For 3000 Feet Per Minute Annular Velocity

Hole Dia. Inches D_3	O.D. DRILL PIPE SIZE D_2						
	2⅞" Q cfm*	3½" Q cfm*	4½" (4x4 sq) Q cfm*	5½" Q cfm*	6⅝" Q cfm*	7" Q cfm*	8⅝" Q cfm*
4¾"	234	169	.....	.....	.....	.....	.....
5⅝"	382	318	.....	.....	.....	.....	.....
6⅛"	.....	439	308	.....	.....	.....	.....
6¾"	.....	545	414	.....	.....	.....	.....
7⅞"	.....	690	559	395	.....	.....	.....
7⅞"	.....	814	683	520	.....	.....	.....
8½"	.....	.....	851	687	464	.....	.....
8¾"	.....	.....	921	758	535	451	.....
9⅝"	.....	.....	.....	1,021	798	714	.....
9⅞"	.....	.....	.....	1,101	877	794	.....
10⅝"	.....	.....	.....	1,352	1,129	1,045	630
11"	.....	.....	.....	1,485	1,262	1,170	763
12¼"	.....	.....	.....	1,960	1,737	1,654	1,238

Q* Cubic feet per minute of free air required for annular velocity of 3,000 feet per minute.

Courtesy Hughes Tool Co.

For shallow holes, the effect of friction may be safely neglected and the calculation of volume becomes a simple velocity-area-volume relationship. These requirements are presented in the Table 3.

If velocities of 2000 feet per minute are desired (and this has been satisfactory) a conversion can be made by multiplying the volume given at desired hole and pipe size by two-thirds.

Q. *What type well logs can be used in dry air-drilled holes?*

A. The induction log is adequate and can replace the regular spacing commonly associated with other logs. There is no log to replace the micro-log in an air-drilled hole; however, the Neutron log does, to some extent. That is, in a dry hole in the presence of formation gas, the neutron reading is high and the neutron curve does not give reliable porosity determinations.

Gamma Ray can be run successfully in a dry hole; however, the neutron curve may be seriously affected if the hole size is greater than eight inches. Thus, the type logs available to an air-drilled hole are: Two radio-active logs, and the induction log plus a temperature log.

In the San Juan Basin area where air has been widely used, the appearance of the neutron and induction curves are very similar. This may be true for other areas.

Recycling gas . . .

Q. *Can gas used for drilling be cleaned and recycled?*

A. There have been several experiments in separating the cuttings and recycling the gas. The large amounts of cuttings to be removed has made this uneconomical to date but there is no reason why this method could not be improved upon. Especially important would be a closed system utilizing some inert gas such as nitrogen. New cyclone type dust separators may find a substantial market for this usage.

Rotating drilling heads . . .

Q. *What is a rotating blowout preventer?*

A. It is essentially a rotating wellhead which maintains a constant seal around all of the rotating elements in the drill string except such large diameter pieces as the

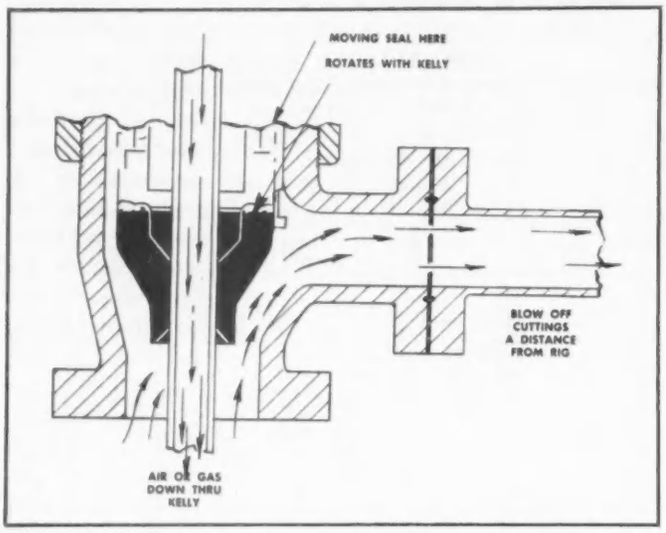


Fig. 3—Air or gas drilling diagram through the rotating blowout preventer.

bit or reamer. This unit seals off around any shape of kelly and will also seal on any type of drill pipe whether flush joint, upset or coupled. Its ideal use is for:

- Circulating with air or gas.
- Drilling under pressure.
- Drilling with reverse circulation.
- Drilling in areas susceptible to blowouts.

It is necessary when using air or gas as a means of removing drill cuttings to provide a sealing unit across the annulus and around the drill string. The returning gas or air is directed out of the well through a flanged outlet below the sealing point and to a conductor pipe which leads to the disposal area. This packing element must be able to rotate with the string and provide absolute packoff during all drilling operations.

Coring is faster . . .

Q. *Can core samples be taken when using air?*

A. Many operators have reported excellent core times and recovery. The core is thought to be free of contamination—more closely resembles its virgin state. Both conventional and diamond core head have been used. Coring time usually is much faster.

Reversing circulation . . .

Q. *What about the use of reverse circulation?*

A. Reverse circulation has been tried by a number of operators for completion work, for air drilling, and for fishing. Because of the higher temperatures possible, it is desirable that reverse circulation be used when it is necessary to dry out a hole. But in lost circulation formations reverse techniques cannot be used.

When used for drilling-in operations, reverse circulation has the disadvantage (because of the accompanying high temperatures) of driving off the lighter hydrocarbon components, unless adequate after-coolers are used. Some operators believe that reverse circulation could cause the bit to plug if too much weight is applied to the bit. (Bits wear out sooner.) The principal advantages of reverse circulation, however, remain to be:

- Lower compressor pressures may be used in some cases.
- High-velocity return of the cuttings.
- Larger cuttings for geological analysis.
- Easier fishing under certain circumstances.
- Less formation contamination under certain circumstances.

What weights to use . . .

Q. *What weights are used on the bit during air drilling operations?*

A. For air drilling, bit weights of approximately half those used to drill the formation using conventional mud frequently have been reported. Approximately the same rotary speeds are used. However, weights and RPM conditions are not nearly so well established as for mud drilling.

Some operators feel that heavier weights might be used to an advantage provided that the cuttings could be blown from the hole fast enough. Of course a fear of crooked holes has dictated the relatively light weights used by some operators. (This also needs study.)

For aerated mud drilling the problem is some different since the weight and RPM are comparable to mud drilling.

Q. *What bits should be used in the different formations when air drilling?*

A. Operators generally can expect that any bit that would do a good job using mud also will perform with air. Many operators like to use the next harder formation bit when drilling with air on the theory it will last longer and will produce smaller cuttings better adapted to removal with air. This practice is not yet firmly established and experimentation by operators is suggested.

With aerated mud drilling, the same bit as used in conventional mud drilling is used.

Control of crooked hole . . .

Q. *Is the crooked hole problem aggravated by use of air as drilling medium?*

A. In spite of the fact that some operators believe that light weight permissible with air drilling relieves the crooked hole problem, the consensus is that the control of deviation is a more serious problem when air is used.

Cuttings can be identified . . .

Q. *Can well cuttings be identified geologically? How much is the time lag?*

A. Cuttings are accelerated to the surface within a very short time. On shallow wells within seconds. Therefore identification of samples is almost simultaneous.

Geologists, who have done a spendid job overcoming the problems of reading emulsion fluid samples, are finding that identification of air or gas drilled samples falls into routine once experience is gained. The reading is not easy but a number of companies

SMOOTH SERVICING

ON DEEP WELLS

MOGUL *Torcair* 42 Single or Double Drum Winch

CAPACITY: SERVICING WELLS TO 10,000 FEET With 2½-Inch Tubing, Without Hydromatic Brake — **SERVICING WELLS TO 16,000 FEET** With 2½-Inch Tubing, With 15" Double Rotor Hydromatic Brake . . . **AND NOTE THESE:** • **FULL AIR CONTROLS** • **FULL OIL BATH CHAIN DRIVES** • **LOWER DRUM BRAKE RINGS 42" x 8½"** • **WILSON QUALITY THROUGHOUT** • **TORQUE CONVERTER APPLICATION** —

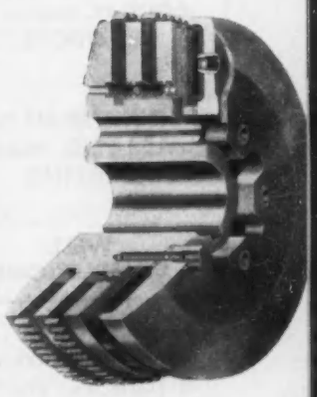
Either a Torcon Torque Converter, Twin Disc or GM Converter can be used with any single engine Torcair Rig or Winch.

Complete Portability! Under 8 Feet in width!

Be Modern - Buy Wilson

ALL DRIVES EQUIPPED WITH

WICHITA AIR-TUBE DISC CLUTCHES



This type of clutch combines all the advantages inherent in air operation, such as convenient remote control, small manual pressure required for full torque, smooth starting and controlled torque. In addition, it gives freedom from self-engagement or reduced capacity, due to centrifugal force; and has much greater torque capacity than radial type air clutches. No packing to leak or let water or oil into the clutch friction surfaces. All air connections are on the outside and easily accessible. This without a doubt the finest clutch yet developed for this type service, providing great capacity in minimum space, no adjustments, practically impossible to burn up. **SMOOTHEST ENGAGEMENT OF ANY AIR CLUTCH!**

HYDROTARDER BRAKE APPLICATION

HYDROTARDER: The Mogul unit can be equipped with the 15" Double Rotor Type Hydromatic Brake driven by a chain drive from the countershaft. This brake can be used with either upper or lower drum, and when used on main drum with five lines strung up will absorb a total of 1300 H.P. when dropping the stands at the rate of 60 feet in 12 seconds. This is the equivalent of 16,000 feet of 2½" tubing. The brake is so arranged that it will absorb very little power when taking up the empty blocks and jaw clutch does not need to be disengaged to take up the empty blocks when the trip is completed.

Wilson

The FIRST NAME in OIL FIELD WINCHES

WILSON MANUFACTURING CO., Inc.

The HOME of RED IRON • Wichita Falls, Texas

BOX SCORE ON CURRENT AIR DRILLING EXPERIENCE

	COMPRESSOR DEMANDS	HOLE CONDITION
SHOT HOLES Depth: 10 ft.-200 ft.	Demands large volume low pressure compressor. Blowers have been used.	
RAT HOLE MOUSE HOLE Depth: 20 ft.-40 ft. Diameter 8 3/4 in. up-(Ave. 12 in.)	Demands large volume low pressure compressor. Blowers have been used.	
SURFACE HOLE Depth: 50 ft. to 3000 ft. Ave. Diameter hole 12 in. and larger up to 30 in.	The large diameter hole demands volumes of 600 CFM to 5000 CFM at pressures from 20 to 250 psi. (Refer to Table 3 for specific volume requirements for hole size and drill pipe size.)	In presence of water, compressor must be capable of lifting hydrostatic columns. Pressures in excess of 125 psi highly recommended. It appears 200 psi needed to drill to 700 ft/w hole full of water.
BELOW SURFACE 200 ft. to 3000 ft. Diameter varies from 4 3/4 in. to 9 7/8 in.	Compressor demands of 750 to 2000 CFM @ 40 to 125 psi most commonly used. (Refer to Tables 1 or 2) Higher pressure desirable for emergency.	No water present. In presence of water, present experience indicates pressure of 300 psi as more desirable.
BELOW SURFACE 3000 ft. to 6000 ft.	Compressor demands of 1000-1800 CFM @ 60 to 200 psi most commonly used. (Refer to Tables 1 or 2.) Higher pressure desirable for emergency.	No water present. In presence of water experience indicates pressure upward to 850 psi desirable.
BELOW SURFACE 6000 ft. below to 12,000 ft.	Compressor demands of 1000 to 2500 CFM @ 80 to 300 psi most commonly used. (Refer to Tables 1 or 2) Higher pressure desirable for emergency.	No water present. In presence of water, pressure upward to 1000 psi desirable.
REQUIREMENT FOR AERATED MUD DRILLING	1 MMCFD to 3 MMCFD @ 500 to 1500 psi.	Limited water tolerated.
WELL COMPLETIONS	Higher pressure generally required. 250 psi to 400 psi have been reported.	

have set procedures and are not bothered by the size of particles. The color of the dust on flow line flame frequently aids geologist.

Consulting geologists specializing in air drilled sample identification now offer services in some West Texas and Colorado drilling areas. Ample testing, coring, and logging techniques are available.

Cuttings are not all small dust particles. Improved sample traps will soon aid the geologist and new drill pipe sample catchers hold promise for future.

Why higher velocities?

Q. *Why do some operators attempt to use 4000 to 5000 feet per minute annular return velocity instead of 3000 feet generally accepted as a desirable figure?*

A. It depends on the maximum size particle to be supported. The higher figures are based on 3/8-inch particles. (Early gas drilling by El Paso Natural Gas company used a return velocity of this magnitude or greater.) However, many operators have had excellent results with velocities as low as 2000 feet per minute. This is reasonable because regardless of the maximum particle size it is believed that most cuttings are considerably smaller. Some operators report they can detect no increase in penetration rate above 3000 feet per minute. One leading bit manufacturer reports that bottom hole cleaning appears to be substantially complete at these velocities.

Of course, it is undesirable to use any higher return velocity than necessary because of cost of equipment and fuel necessary. More rapid erosion of pipe is possible with excessive return velocities.

Air Drilling Ideas That May Pay Off

One thing is certain—water is a deterrent. Here are some suggested solutions to this and other major problems.

Combating wet formations . . .

Q. *What methods or materials have been used to combat formation water difficulties, and what method has been the most successful?*

A. It is known that materials or various chemicals have been tried to accomplish the following purposes:

- To dry up the formation facies.
- To waterproof cuttings.
- To squeeze or block off water zones.

It is anticipated that "squeezing" or protective casing of the hole, will have to be done sooner or later when a prolific wet zone is encountered. Other problems which must be faced in combating water:

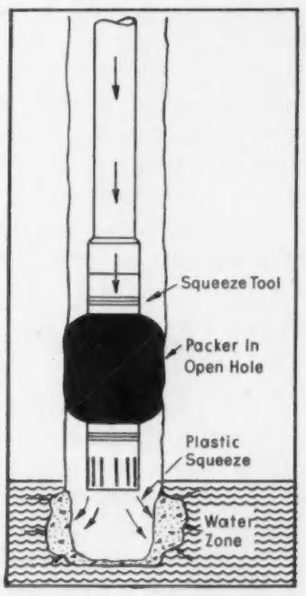
- The disposal of the volumes of water produced. (This is an especially severe problem in case of salt or sulfur water.)
- The problem of drill pipe corrosion might become severe under certain conditions.
- In the case of aerated mud drilling, the dilution of mud conditioning chemicals is a problem.
- Certain bentonitic and sloughing formations can pose a severe problem (perhaps even loss of the hole) when water is encountered.
- In case of water production, a satisfactory squeezing of the productive zone should solve the problem.
- In the case of sloughing formations, aerated mud seems to be the only solution in sight.
- It is anticipated that in areas where sloughing formations are a serious problem, air drilling may be confined to development drilling where casing and drilling can be planned carefully.
- Any production of water will increase bottom-hole pressures and tend to decrease the benefits of drilling rates to be expected.

It is anticipated that tomorrow's air drilling might be used under nearly every conceivable condition. However the economic advantages will be more than offset by the added cost incurred combating water under certain severe conditions.

Q. *At the surface, how can you detect presence of water?*

A. Small amounts of water can be detected by the significant reduction in the amount of dust and the presence of mud pellets in dust exhaust. (This is the most dangerous condition from the standpoint of sticking the drill pipe.) Immediate steps should be taken to prevent sticking. These are:

- Stop drilling and blow formation in an attempt to dry up formation. Some operator recommended reversing circulation, so the high temperature air is in contact with the formation face.
- Reduce drilling rate in attempt to increase the air-to-rock chip ratio.
- Inject water to increase water-to-rock chip ratio.



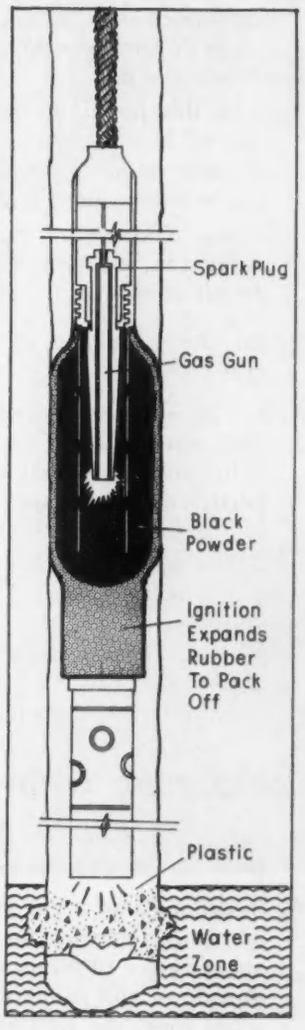


FIGURE 4

WILL WATER BE SEALED OFF by plastic or chemical squeeze technique like this? (See above left.) The method has to be fast, economical and effective—or it would be more advantageous to use mud. Preference is for a tool that can seal off zones as drilling progresses.

•

MAYBE THIS IS THE ANSWER. Some people feel that (dry or wet) chemicals or plastics can be extruded back into the formation by the wire line cementing tool (right). This tool has conquered water problems by squeezing perforations and sealed off leaky shoes and bridge plugs. The detonation is controlled electrically from the surface after the tool has been run into the hole on a wire line to the desired depth. As the gases from the detonation of the powder charge expands the rubber packer element against the sides of the hole the bottom plug is sheared—pinpointing the cement, plastic or chemicals from the tool into the water zone. Perfection of this technique holds promise.

Which technique to use under any condition depends on the judgment of the operator.

Virtual elimination of the dust and the presence of a substantial water spray indicates that substantial water production imposes no immediate threat to the drilling, provided:

- There is sufficient compressor pressure to lift the water.
- There are no sloughing formations above water producing zones.

If serious sloughing conditions are believed to exist,

the hole should be mudded up at once with an appropriate mud and mud drilling should continue until protective string is set.

If no sloughing is expected, air drilling should continue through the wet formation. This usually can be determined if the driller watches for the first sign of bit sticking. (One operator reports this frequently happens about five feet below wet zone but probably varies drastically with volume of water and character of formations.

At this point, the operator can either squeeze or case off the wet formation immediately or if volumes of water do not present too serious a problem, drilling may continue until a more convenient time.

Any tendency of bit to stick may sometimes be avoided by injection of suitable quantity of water into the air stream.

Q. *Are the techniques of combatting water well developed?*

A. No, the entire subject of combatting water in air drilling is very much in its infancy and undoubtedly new techniques to combat specific problems will emerge. Further experience may disclose new techniques which will be preferable to those outlined.

The chemical and petro-chemical industry may well find a prolific market here. Regardless of what the future may hold—the one key to combatting water is adequate compressor capacity, (pressure). However in presence of high volumes it is doubted that pressure would offer any advantage.

Completing with air . . .

Q. *Can air be used to drill into gas and oil formations? How can production be detected?*

A. In drilling into a gas zone, the pilot light on the flow line ignites showing the presence of gas. The operator has a choice of either drilling ahead at that point or shut down and gauge what he already has. In drilling a gas zone, the well gas is beneficial in bringing the cuttings out. The gas volume entering the well gives added lift.

One operator has found that when the bit hits instantaneously and the well starts making oil, stains can be noticed at the flow line. The footage of oil bearing sand drilled is dependent upon the fluid entry into the hole. The "balling up" action of the cuttings mixing with oil is not noticeable but they have a sticking effect similar to when drilling into water. While drilling with air a small back pressure is created on the sand, due to the air pressure.

Bore hole camera . . .

Q. *What other tools will aid the geologist in evaluating underground formations?*

A. A pilot model of a camera using a conical, truncated mirror has been developed and holds promise. Taking

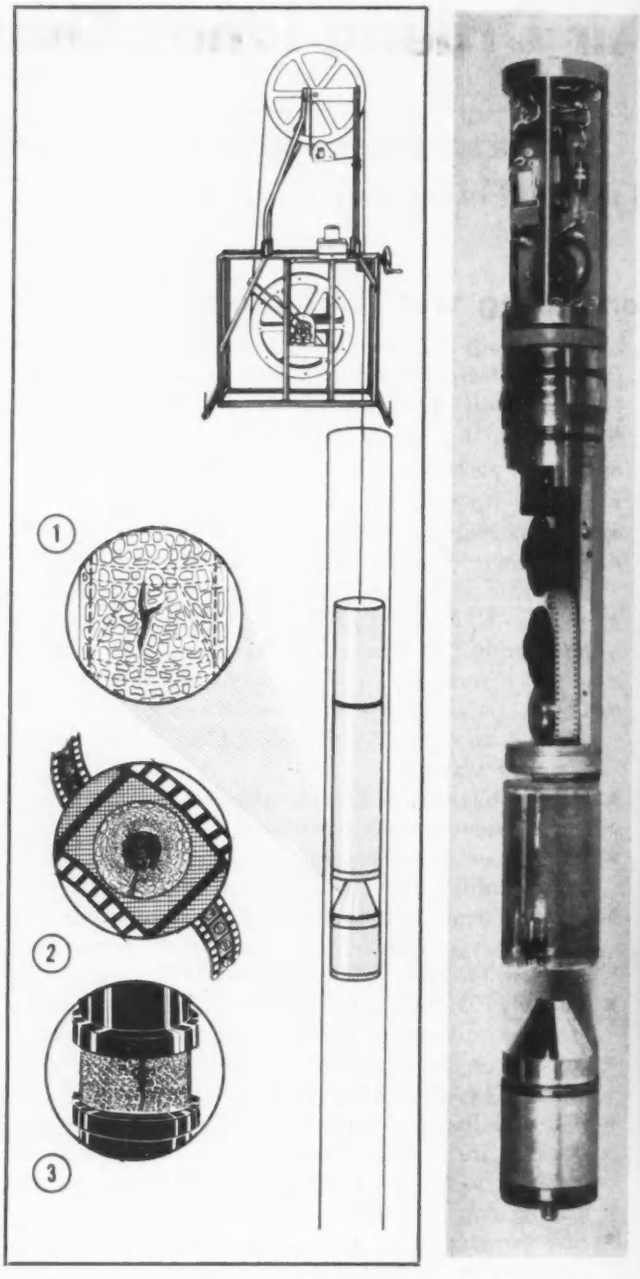


FIGURE 5

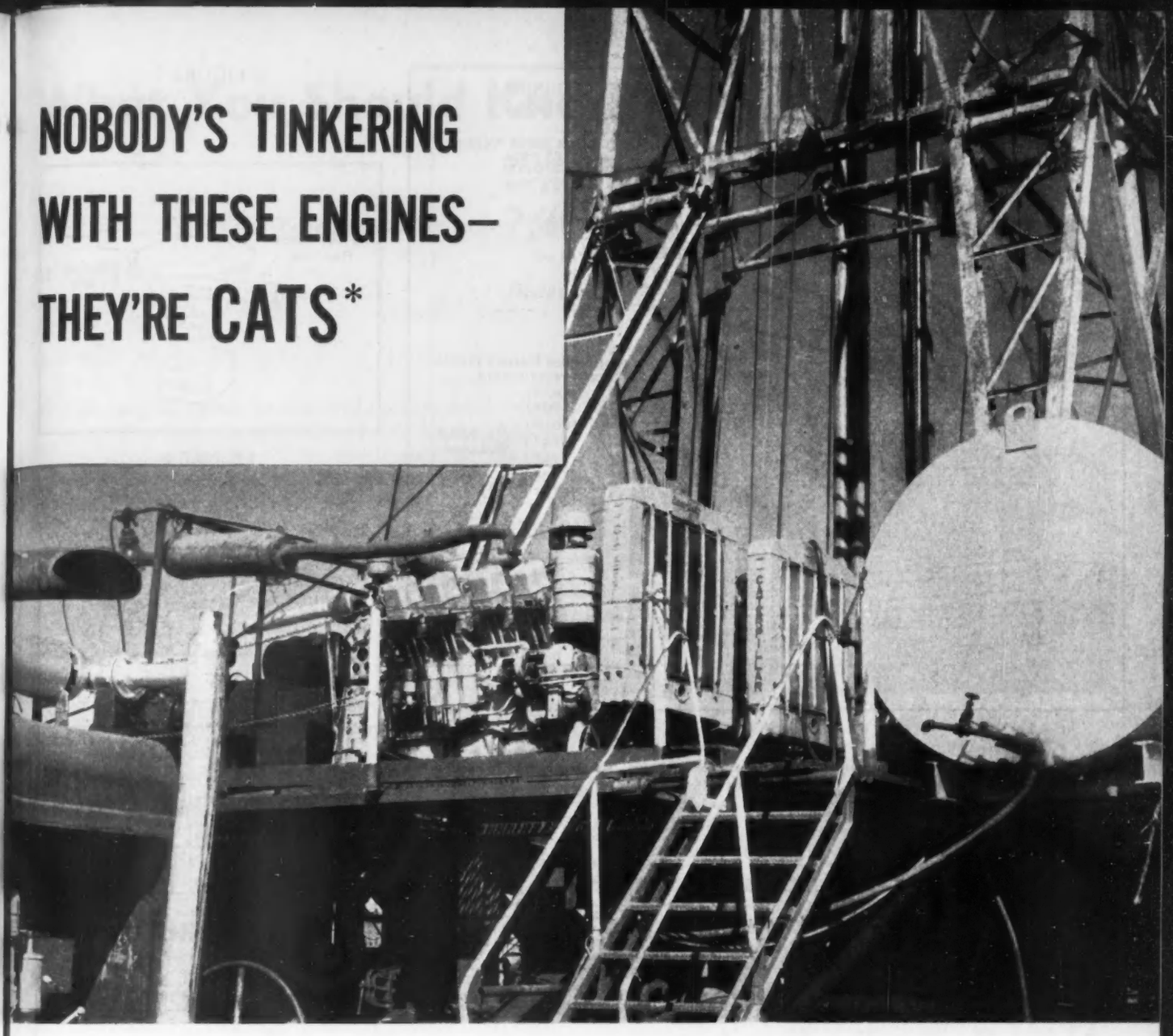
1. A small section of bore hole as it appears to camera. As it is lowered into bore hole, it automatically photographs side-wall which can be viewed through a three-dimensional projector.
2. A single exposure reveals a circular image representing 360-degree surface of bore hole.
3. Circular section as it appears through projector.

At right is a photograph of the camera.

16 color pictures per foot of the bore hole might provide accurate information regarding underground conditions, water entry, lost circulation zones, and fishing problems. Orientation of faults, contacts, fractures, and bedding planes is achieved by showing compass in each picture. Limited to 500 feet of hydrostatic head, this camera after modifications may be capable of producing continuous undistorted cylindrical pictures of dry bore holes and of deeper water filled holes than now possible. Presently, this equipment is quite expensive.

Small diameter bore hole television cameras are also on the drawing boards.

NOBODY'S TINKERING WITH THESE ENGINES— THEY'RE CATS*



Three Caterpillar Oilfield Diesels are providing *steady, dependable* power on this drill rig 40 miles northwest of Los Angeles.

Who says they are *steady* and *dependable?* They say it themselves! Just listen:

Two D17000s pull the draw works on this National No. 50 Drill Rig for Dunlap & Graham, Inc. They'd been on the job a long time when this picture was taken. One had 23,028 hours; the other, 32,039 hours!

Any oilfield diesel would be justified in faltering a few times over that long stretch. Any *ordinary* engines, that is—not Cat Oilfield Diesels! The full extent of repairs on these engines after thousands of hours of service was *one overhaul each!*

Naturally, there had been *no* repairs on the rugged Caterpillar D13000 Diesel driving the 7¼" x 10" Gardner-Denver Pump. It was a mere youngster with only 7346 hours.

Now you see why the adjectives "steady" and "dependable" are used so often with Caterpillar. And you can understand why so many drillers have decided that there is savings in numbers with Cat Oilfield Engines.

Standardize on Caterpillar. Your operators and mechanics will become familiar with one make. Parts inventory can be practically eliminated, since many engine parts are interchangeable. And you benefit from quick, reliable *one-stop* field service from *one* dealer. You get that service anywhere, day or night.

Be sure to specify Caterpillar Oilfield Engines when you repower or buy new equipment. Leading manufacturers of oilfield equipment can supply them!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

SPECIFY CAT POWER FOR HIGH-PROFIT PERFORMANCE

♦ FIGURE 7

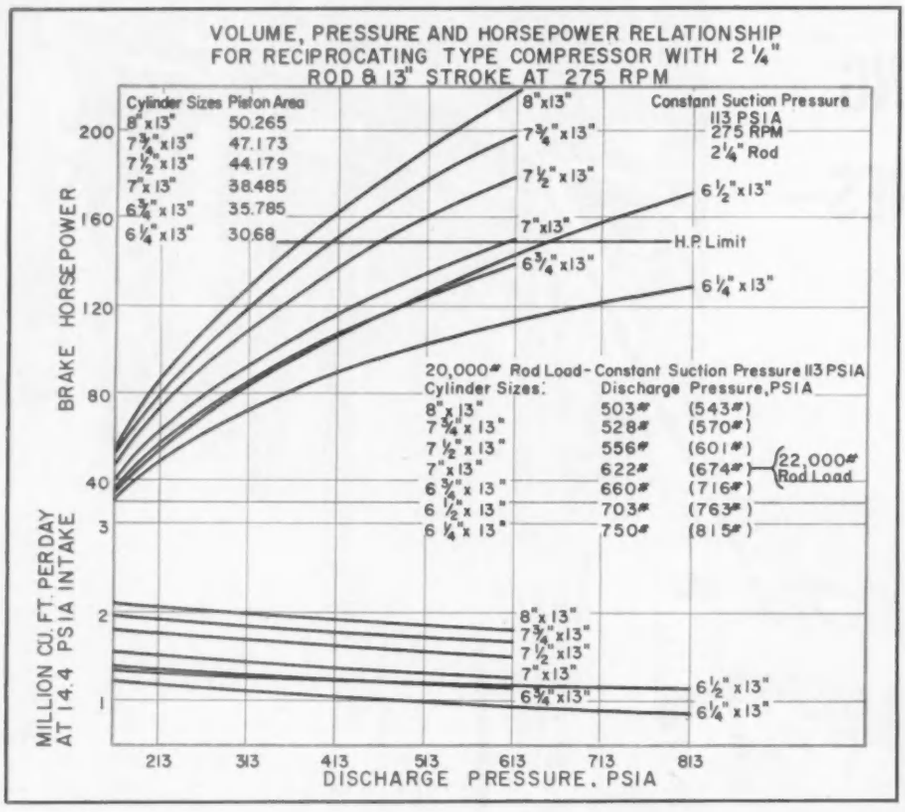

VOLUME, PRESSURE AND HORSEPOWER RELATIONSHIP
FOR RECIPROCATING TYPE COMPRESSOR WITH 2 1/4"
ROD & 13" STROKE AT 275 RPM
Cylinder Sizes Piston Area
8" x 13" 50.265
7 3/4" x 13" 47.173
7 1/2" x 13" 44.179
7" x 13" 38.485
6 3/4" x 13" 35.785
6 1/4" x 13" 30.68
Constant Suction Pressure
113 PSIA
275 RPM
2 1/4" Rod
H.P. Limit
20,000# Rod Load - Constant Suction Pressure 113 PSIA
Cylinder Sizes: Discharge Pressure, PSIA
8" x 13" 503# (543#)
7 3/4" x 13" 528# (570#)
7 1/2" x 13" 556# (601#)
7" x 13" 622# (674#)
6 3/4" x 13" 660# (716#)
6 1/2" x 13" 703# (763#)
6 1/4" x 13" 750# (815#)
22,000# Rod Load
BRAKE HORSEPOWER
MILLION CU. FT. PER DAY AT 14.4 PSIA INTAKE
DISCHARGE PRESSURE, PSIA
213
313
413
513
613
713
813

TABLE 4

Theoretical Horsepower Required to Compress Air From Atmospheric Pressure to Pressures

Discharge Pressure			MEAN EFFECTIVE PRESSURES							
			Isothermal Compression, Single or Multistage		ADIABATIC COMPRESSION*					
					Single-Stage		Two-Stage			
Psig.	Psia.	Atm. Abs.	Mep	Theoretical HP. per 100 Cu. Ft.	Mep	Theoretical HP. per 100 Cu. Ft.	Mep, Psi. Referred to Low-press. Air Cylinder	Theoretical HP. per 100 Cu. Ft.	Theoretical Inter-Cooler Gauge Pressure	Percent of Power Saved by Two-Stage Over Single-Stage Adiabatic Compression
5	19.7	1.34	4.13	1.8	4.48	1.96				
10	24.7	1.68	7.57	3.3	8.21	3.58				
15	29.7	2.02	10.31	4.5	11.4	5.0				
20	34.7	2.36	12.62	5.5	14.3	6.2				
25	39.7	2.70	14.68	6.4	16.9	7.4				
30	44.7	3.04	16.30	7.1	19.2	8.4				
35	49.7	3.38	17.90	7.8	21.4	9.3				
40	54.7	3.72	19.28	8.4	23.4	10.2				
45	59.7	4.06	20.65	9.0	25.2	11.0				
50	64.7	4.40	21.80	9.5	27.0	11.8				
55	69.7	4.74	22.95	10.0	28.7	12.6				
60	74.7	5.08	23.90	10.4	30.3	13.3				
65	79.7	5.42	24.80	10.8	31.9	13.9				
70	84.7	5.76	25.70	11.2	33.3	14.6	29.2	12.8	20.6	12.3
75	89.7	6.10	26.62	11.6	34.7	15.2	30.3	13.3	21.6	12.5
80	94.7	6.44	27.52	12.0	36.0	15.7	31.3	13.7	22.7	12.7
85	99.7	6.78	28.21	12.3	37.3	16.3	32.3	14.1	23.6	13.5
90	104.7	7.12	28.93	12.6	38.6	16.9	33.2	14.5	24.5	14.2
95	109.7	7.46	29.60	12.9	39.8	17.4	34.2	14.9	25.5	14.4
100	114.7	7.80	30.30	13.2	40.9	17.9	35.0	15.3	26.3	14.5
110	124.7	8.48	31.42	13.7	43.2	18.9	36.7	16.1	28.1	14.8
120	134.7	9.16	32.60	14.2	45.2	19.8	38.3	16.8	29.8	15.1
130	144.7	9.84	33.75	14.7	47.2	20.7	39.6	17.3	31.5	16.4
140	154.7	10.52	34.67	15.1	49.2	21.5	40.8	17.9	32.9	15.7
150	164.7	11.20	35.59	15.5	51.0	22.3	42.3	18.5	34.5	17.1
160	174.7	11.88	36.30	15.8			43.6	19.0	36.1	
170	184.7	12.56	37.20	16.2			44.7	19.5	37.3	
180	194.7	13.24	38.10	16.6			45.8	20.0	38.8	
190	204.7	13.92	38.80	16.9			46.8	20.4	40.1	
200	214.7	14.60	39.50	17.2			47.8	20.9	41.4	
250	264.7	18.00	42.70	18.6			52.5	22.7	47.6	
300	314.7	21.40	45.30	19.7			56.5	24.5	53.4	
350	364.7	24.81	47.30	20.6			59.6	26.1	58.5	
400	414.7	28.21	49.20	21.4			62.7	27.4	63.3	
450	464.7	31.61	51.20	22.3			65.3	28.6	67.8	
500	514.7	35.01	52.70	22.9			67.8	29.6	71.2	
550	564.7	38.41	53.75	23.4			70.0	30.6	76.3	
600	614.7	41.81	54.85	23.9			72.3	31.3	80.5	

* Based on value for n of 1.3947.

Reference—Compressed Air Handbook—Page 6-78.

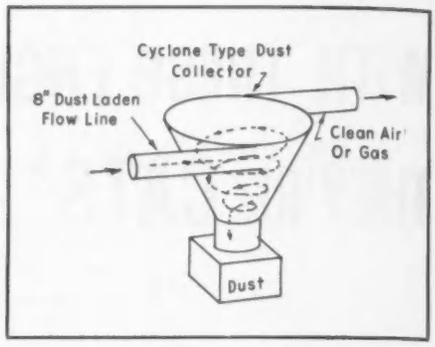


FIGURE 8

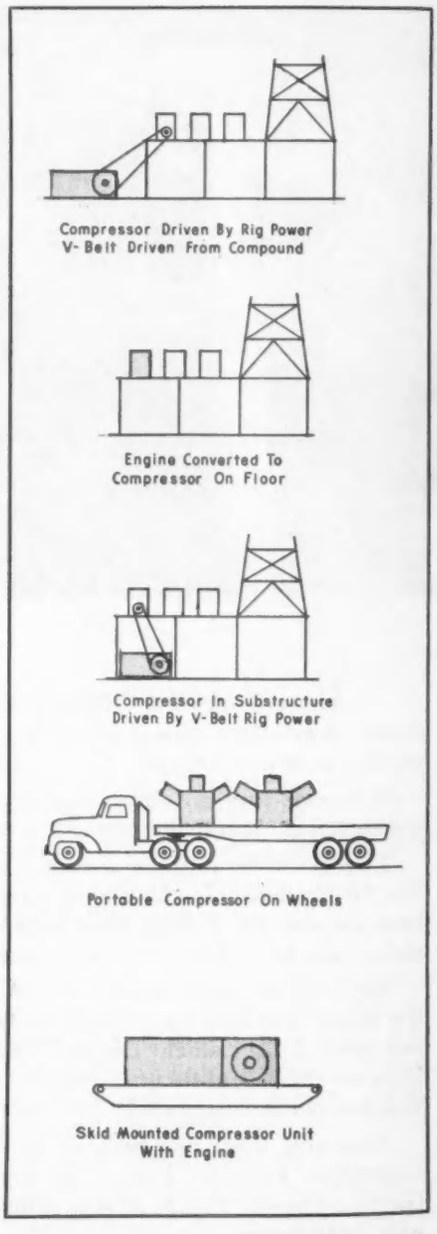

Compressor Driven By Rig Power V-Belt Driven From Compound
Engine Converted To Compressor On Floor
Compressor In Substructure Driven By V-Belt Rig Power
Portable Compressor On Wheels
Skid Mounted Compressor Unit With Engine

Fig. 9—Future compressor equipment will be driven independently or driven by rig power. Sketches here show arrangements now contemplated.

What You Should Know About Equipment

The air compressor is being put to a new use. Equipment may be purchased or rented.

Q. *What is the investment in special equipment required for air drilling?*

A. This question cannot be answered because the development of compressors and drilling heads for the purpose is proceeding rapidly, and the development of dust collectors and mud separators (for aerated mud drilling) is in its infancy.

Earl Bruno reported on costs on Page 132-134 January WORLD OIL, but it must be borne in mind that high compressor capacities and pressures will be necessary to combat water and the cost of this equipment must be obtained from compressor manufacturers. Drilling heads rent for $400 to $800 a month.

One rule of thumb for roughly estimating rig powered compressor equipment is to obtain the theoretical horsepower from Table 4 and allow about $40 a horsepower. If engines are also required, add the cost of engines. This will give the operator the magnitude of investment, but should not be considered accurate.

Q. *How many stages are being used?*

A. Some contractors report five stages, but many believe two to three stages will be adequate.

Effect of altitude . . .

Q. *Will a compressor operated at 10,000 feet altitude perform differently than at sea level?*

A. The efficiency of the compressor will be reduced considerably. The barometric pressure at 10,000 feet altitude is 20.58 inches of mercury as compared to 29.92 inches at sea level. The barometric pressure should be known to make proper calculations of air flow and for determining absolute intake pressure. The actual delivery capacity of an air compressor must always be referred to the actual conditions of temperature and pressure at the compressor intake. (See Table 5).

TABLE 5
Atmospheric Pressure and Barometer Readings at Different Altitudes

Altitude Above Sea Level, Feet	Atmospheric Pressure, Psi.	Barometer Reading in Mercury
0	14.69	29.92
500	14.42	29.38
1,000	14.16	28.86
1,500	13.91	28.33
2,000	13.66	27.82
3,000	13.16	26.81
4,000	12.68	25.84
5,000	12.22	24.89
6,000	11.77	23.98
7,000	11.33	23.09
8,000	10.91	22.22
9,000	10.50	21.38
10,000	10.10	20.58
11,000	9.71	19.75
12,000	9.34	19.03
13,000	8.97	18.29
14,000	8.62	17.57
15,000	8.28	16.88

Reference: Compressed Air Handbook Page 6-83.

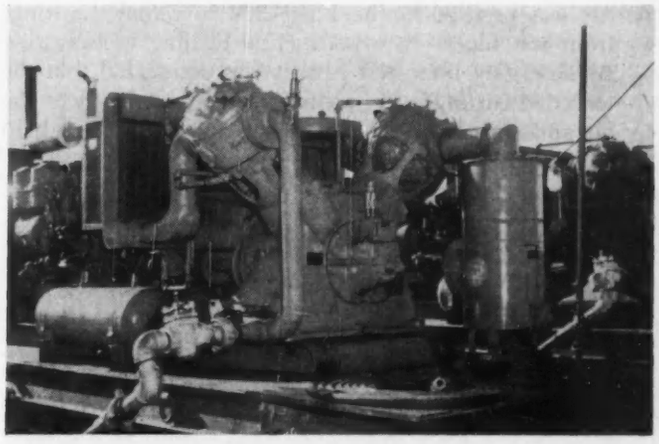


Fig. 6—Air compressors used for drilling operations in Rocky Mountain area. Note that the two compressors capable of 2 Mmcf per day at 260 psi are mounted on truck bed, complete with engines, after-coolers, and inter-coolers.

Consider these factors . . .

Q. *What factors should be considered in the purchase or rental of suitable compressor equipment?*

A. Among those items to be considered are:

- Frequency in which air drilling is to be used.
- Availability of suitable self-contained rental equipment.
- Rental rate as purchase price on suitable equipment.
- Availability of trained personnel. Several leading air drilling operators seem to prefer the rental of self-contained compressors (complete with trained engineering personnel) from service companies.
- Availability of rig power to be used in air drilling and cost of suitable power take-off equipment. (See Table 4. For booster equipment refer to Figure 7.)

Use a dust collector . . .

Q. *What hazards and problems do the cuttings in the form of dust present?*

A. At best, dust is inconvenient and will shorten the life of equipment. One state has strict regulations regarding the control of dust. These regulations were developed to protect miners but some expect them to be used to control dust from air drilling operations. It is believed that as air drilling becomes more widespread, regulations to control the dust will be extended.

Simplest way to control dust is by means of a water spray in the dust exhaust line. Another way which should be even more satisfactory is the use of a cyclone type dust collector. (Figure 8.)

How Bits Drill With Air

Here is an explanation of why air drilling permits faster penetration in most formations.

Q. *How do bits drill and how do cuttings come off bottom when using air medium?*

A. Air was used as far back as 1938 to remove cuttings from test blocks in experimental drilling laboratories. By observing these test runs it was concluded that the loosened cuttings were picked up by the velocity of the air and started on their upward travel as though held in a fluid.

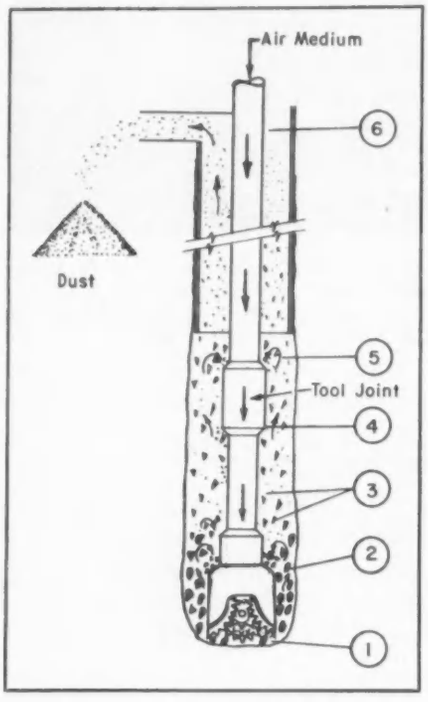


FIGURE 10

1. Compressive force of bit tooth explodes various sized cuttings into air stream.
2. Some rig cuttings are too heavy to be lifted to the surface by air pressure available.
3. High velocity air around streamlines of drill pipe causes a turbulence in which some cuttings whirl, some fall back.
4. Some cuttings strike tool joints, each other, and hole walls. They are shattered into many smaller pieces.
5. Smaller pieces accelerate up hole, getting smaller from multi-impacts.
6. A high percentage of the cuttings are dust particle size at the surface. But many large cuttings are found.

The size of the particle determined its rate of travel and the rapidity with which it left the cutting surface. If the weight of the particle was small it was quickly cleaned from the surface being drilled. If the weight of the particle was large it usually had to be recut before being removed from the surface being drilled.

The shape of the particle also is important. A relatively thin chip but large in cross-section area will be removed more quickly than a particle approaching the shape of a sphere.

Cutting or fracturing is done by subjecting the formation to compressive loads greater than its ultimate strength. Compressive loads are applied dynamically as the rock bit rotates and the cutter teeth contact the formation. This dynamic loading plus the resilience of the formation causes the particle to "explode" or at least be broken from its bedding plane. When this occurs, the material which failed under each rock bit tooth during the time it is contact with bottom is lifted by the air into the annulus, partly as large chips and partly as pulverized material with all sizes between.

Chips crushed to dust . . .

Q. *How do you account for dust particle sizes?*

A. With air as a circulating medium a portion of the rock which fails under compressive loading during the time individual teeth are in contact with bottom is of very fine or dust size particles. The large size chips and those of smaller size are recovered at the surface when drilling shallow holes in quarry operations.

In the deeper holes, such as those encountered in drilling for oil or gas, it of course is impossible to have a uniform particle size and there exists a range of sizes from fine to coarse. As the particles leave the bottom and start up the annulus there are sections of the hole where the return air velocity is not great enough to continue to lift the particles. It is possible that they fall back toward bottom for an interval of time. During this time the drill stem grinds and pulverizes the cuttings against the well bore by rod mill action. The high velocity forces the cuttings to strike each other, the tool joints, and the walls of the hole. This further reduces size and results in a high percentage of dust.

Cuttings thrown into air stream . . .

Q. *What is the "explosion of cuttings" idea?*

A. The "explosion of cuttings" idea refers to the explosive manner in which cuttings are detached from the bottom of the hole by a rock bit tooth. High speed motion pictures of a rock bit drilling under atmospheric conditions reveal puffs of powder plus chips near the penetrating tooth as these particles are suddenly detached from the main body of the formation. This term does not refer to cuttings that explode after they have been removed from the bottom of the hole. This explosive action is, no doubt, more violent with air as a circulating medium than when mud is in the circulating system, since the latter exerts hydrostatic head much greater than when air is in the circulating system, thereby preventing the powdered and small chips from being violently displaced off the surface of the rock being drilled.

Bit nozzles and air flow . . .

Q. *What are the relative merits of jet type nozzles and low pressure nozzles in air drilling?*

A. Experience indicates that jet type nozzles are less effective in drilling than low pressure nozzles when air is used. This fact is true probably because there is less total effect on the bottom of the hole, especially near the center of the bit, when the air is discharged near the diameter of the hole. After the initial expansion of the air after discharge, its energy is quickly dissi-

pated and its most effective area is directly below its discharge point. For this reason one bit company recommends conventional nozzle designs directing the air on top of and past the cutter elements.

The conventional air course would be positioned to direct the air stream onto the cutters and the jet type nozzles are positioned to direct the air stream between the cutters and directly upon bottom. In certain abrasive formations, the use of conventional air courses positioned to direct the air stream onto the cutters results in a sand blasting action of the cutters resulting from a portion of the cuttings being pulled into the relatively high velocity air stream. This sand blasting action can cause severe damage to the cutting teeth and the solution of the problem is to run the jet type bit which directs the air stream directly upon bottom.

Q. *Referring to the above, how about aerated mud drilling?*

A. There should be no appreciable difference in the jet effect of mud and aerated mud, so under proper conditions of velocity and volume the jet nozzle should be more effective.

Q. *What is the current thinking regarding nozzle shapes, size and designs for air drilling? What about designs for aerated water?*

A. Generally speaking, standard nozzle shapes in small size openings have proved to be as effective as any other design. For the most part, one company recommends smaller openings for air than for mud.

Extensive field results in quarry operations and conventional rotary drilling for oil and gas have shown satisfactory results with the same general configuration of nozzle used in conventional rotary bits. Nozzles are circular in cross-section and embody an enlarged upper entrance which tapers to a reduced diameter and becomes cylindrical in cross-section over a length depending upon the size of the nozzle. Nozzle designs for aerated water may differ from standard jet bit nozzles only in that they will be of a reduced size.

Controlling crooked holes . . .

Q. *Do air-drilled wells intensify crooked hole tendencies?*

A. There is evidence that the control of deviation is a more serious problem with air in the circulating system than with mud or water.

Q. *Can air-drilled holes be controlled as easily as mud-drilled, using the Lubinski-Woods principles?*

A. It is not known. Lubinski and Woods assumed frictional effects between the drill string and the wall of the hole can be ignored. These assumptions where mud is used in the circulating system appear to be valid. The friction between the drill stem and the wall of the hole certainly would be higher in a dry hole.

Q. *Do bits need a lubricant when drilled dry?*

A. The results to date on all operations where air or gas has been used as a circulating medium does not indicate any need for the introduction of a lubricant into bit bearings. Bearing life with air or gas in the circulating system has been materially increased compared to bearing life with water or mud in the circulating system. (See page 125, January, 1955, WORLD OIL.)

A lubricant introduced into the air system would tend to lower the friction between the cutter teeth and the formation. It is believed that the high friction obtained with air in the circulating system would be adversely affected by the use of a lubricant.

The only lubricant which is known to have been introduced, has been a relatively small volume of water for the purpose of controlling the dust problem in a certain quarry operation. The small volume of water had no effect upon rock bit performance.

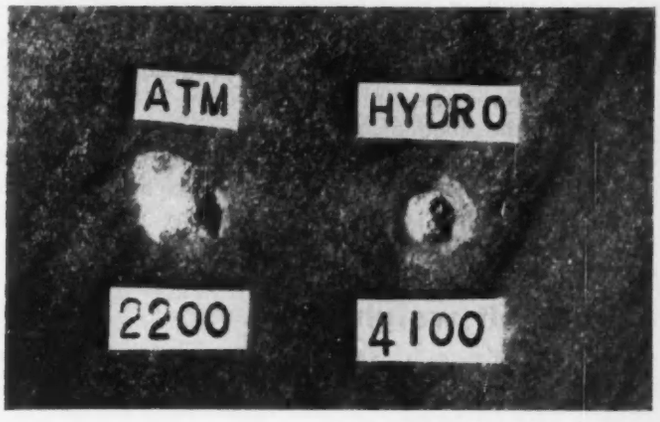


Photo courtesy Hughes Tool Company

Fig. 11—Some rocks drill faster under atmospheric pressure than when subjected to pressure of a fluid column. Shown here are effects of penetrator loads of 2200 psi (under atmospheric conditions) compared to 4100 psi (under 5000 psi pressures).

Comparing bit performance . . .

Q. *Do bits perform differently when air is used as compared to mud?*

A. Yes. There are several reasons for this. Due to the absence of a fluid column on the formation being drilled the pressure on the formation face is less and the explosive effect of the loosened formation is more pronounced and there is less recutting of the loosened particles. This factor alone increases penetration rate and total footage. Due to an absence of moisture the fine abrasive formation particles are more quickly removed and are not held in suspension to act as a lapping compound on bearings and bearing surfaces. This contributes to longer bearing life and better drilling conditions. Adequate air volume more quickly removes the loosened cuttings from their bedding plane because of the air's ability to get under the chip and pick it up. The basic principles of a given type rock bit when drilling a given formation is no different when air is used as a circulating medium compared to mud. The performance results, however, are different and when air is used improved rock bit performance is reflected in greater footage and faster penetration rate. Furthermore, rock bit bearings have a longer life when air is used as a circulating medium compared to water or

mud. The increase in footage per bit at a greater penetration rate in a deep hole is due in part to each of the factors named above and on the character of the formation being drilled.

Q. *How do bits perform with aerated fluid drilling?*

A. A representative of one major oil company that has had extensive experience with aerated mud drilling believes penetration rates and bit footages can be obtained with aerated mud, that are comparable to air or gas drilling. It was further stated that additional air needed with aerated mud is not large, and that the advantages to be gained through safety, handling of moisture (filling the hole and prevention of explosion, etc.), will in time make the aerated mud method highly preferable.

A part of the improvement is probably due to the much lower viscosity of the air and its ability to go under the edge of partially removed chips thereby helping to complete the removal of the chips. Aerating a mud column will, of course, decrease the density of the column thereby reducing the weight acting upon the formation being drilled.

About bit weights . . .

Q. *What is the effect of heavy bit weight on crooked hole conditions?*

A. Weight is the primary cause of hole deviation and only by controlling the effect of the necessary drilling weights are we able to maintain vertical well bores. There is a known case where a crooked hole problem through a given section of formation was largely overcome by reducing the weight on the bit.

Q. *What is the effect of heavy bit weight on modern slim hole bits?*

A. Heavy bit weights are more detrimental to smaller diameter bits because their load-carrying capacity is proportionally so much less as the size is reduced. The smaller the bit the less life expectancy under heavy bit weights. (See Bobo, Hoch, Ormsby, page 152, January, 1955 WORLD OIL.)

Research is needed . . .

Q. *What research should the drilling industry conduct to bring about a quick solution to the unknowns of the air drilling and aerated mud techniques?*

A. Any research program instituted to being about a quick solution to the unknowns of air drilling would be an ambitious undertaking and probably would be beset with many troubles. It appears that the problems and the unknowns of air drilling are essentially the same as those of jet or high discharge velocity drilling. That is, it must be determined what velocities and/or volumes of air must be reckoned with; what design of nozzle will prove under these conditions to be the most effective; what the pressure losses are; what can be done to minimize them and to explore the fringe unknowns which may or may not contribute greatly to techniques employed.

Probably the most effective approach would be the setting up of an active study group composed of members who have a financial stake in the solution and who are willing to furnish the equipment and time necessary to carry out the development work. The problem must be solved under actual drilling conditions. The manufacturers of both the capital and expendable materials should and would contribute to such a group.

A research project to establish an economical and dependable means to control formation water from entering the well bore might be justified in areas where this is the only problem preventing the use of air as a circulating medium.

Techniques and materials to effect sealing of fluid bearing formation is the major need at present. Most important of all is the continued field trial with compressors of adequate size for air and aerated fluid drilling.

Bits to use . . .

Q. *What bits have indicated the most promise for air drilling?*

A. One bit company stated that the conventional designs of cone bits used in rotary oil field drilling have indicated satisfactory performance. In deep drilling, the conventional jet type rock bit or the conventional water course rock bits have been used successfully.

Another bit manufacturer says that any standard rock bit with a design compatible with the formation being drilled will give satisfactory results based upon present standards. No special designs have shown any marked improvement and, generally speaking, standard bits with smaller discharge eyes are used.

A leading air drilling company believes hard formation bits with short teeth result in smaller cuttings, that can be lifted much easier. Diamond bits have shown excellent results in Mesa Verde, New Mexico. In general, all types have been used.

Q. *Why do tungsten carbide bits drill with air?*

A. The tungsten carbide studded bits operate in the same manner upon the formation with air in the circulating system as with water or mud. The advantages referred to above with air in the circulating system compared to water or mud will improve the performance of the tungsten carbide studded bits in the same manner as for a conventional cutter having milled teeth.

Frictional losses . . .

Q. *Under what conditions might one expect frictional losses so severe as to cause insufficient velocity to effectively remove cuttings? Explain.*

A. Frictional losses are accounted for in the charts and tables for the volumetric requirements this issue. Insufficient velocity might be encountered when drilling formations of very high density but under no circumstances is it foreseen that severe frictional losses will

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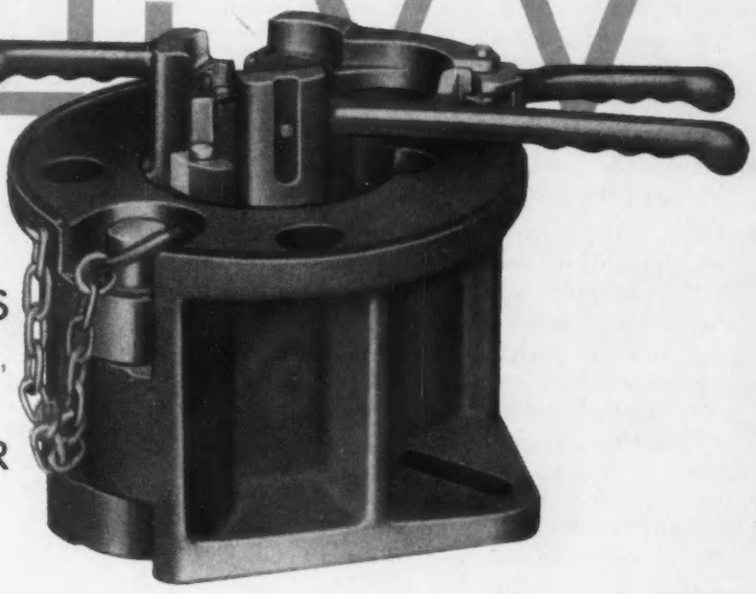

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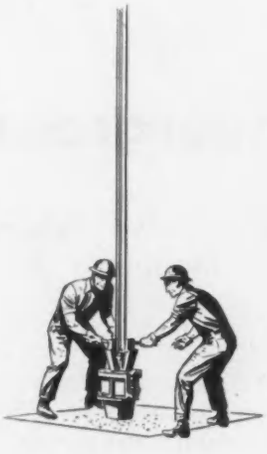

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result in insufficient velocity to remove cuttings effectively.

One might expect frictional losses to cause insufficient velocities for effective cutting removal where the area of the annulus is reduced to the point where insufficient clearance prevents the free flow of the cuttings on their return. This condition could be modified in the presence of moisture in slight amounts.

Q. *What is the basis for the 3000-feet-per-minute annular velocity? What happens when this figure is doubled?*

A. The 3000-feet-per-minute annular velocity has been established from field experience in quarry work. This velocity will lift rock cuttings produced by rock bits to the surface satisfactorily. Occasionally extra large cuttings will be produced. These will be brought to the surface and may be suspended in the air stream around the mouth of the hole until broken up.

The effect of doubling the annular velocity would result in removing more of these larger cuttings without requiring them to be broken again. The higher velocity resulting from doubling the volume of air in the system could also result in erosion on the external surface of tool joints.

Q. *What theories account for fast drilling using air?*

A. The theory of plasticity of formations under pressure is believed by some to be a reason behind the spectacular results frequently reported by air and gas drilling.

- Some believe cuttings are picked off bottom more rapidly by the air thus minimizing the recutting of rock particles.
- The breakage or exploding effect of rock chips fractured by bit teeth are thrown into the air stream instantaneously.
- Some formations have the characteristic of drilling slower when wet.
- Viscosity of the mud slows drilling drastically.
- There probably is also some suppressing action on the cuttings that are not loosened completely by the differential pressure across the interface of the bottom of the hole and by the instantaneous filter cake of the fluid.

The increase in drilling efficiency noted when air is used for circulation probably is a combination of several of these factors.

Fig. 12—Some air bits are puzzling to experts. Bits shown have been used in air drilling and have exceeded the performance that would have been achieved normally by mud. Smooth bit shown at right was pulled even though it was making an unbelievable 40 feet per hour.

Tool joints . . .

Q. *What tool joints offer the most efficient drilling? I.e., flush-joint or double streamline pipe?*

A. An internal-external drill string would appear to be efficient. In practically all rotary drilling where air has been used in the circulating system for deep hole drilling, standard drill pipe has been used successfully. Under certain conditions, such as those existing in the San Juan Basin of New Mexico, square shouldered tool joints have suffered from erosion and that the slim hole design of drill stem has been satisfactory. It is believed that flush-joint or slim hole would perform satisfactorily under all conditions.

Can Explosions Occur Underground?

Damage has been negligible on two reported explosions and three underground fires. An expert sees no direct damage to equipment because of comparatively low pressures developed.

EXPERIMENTAL EVIDENCE has been published on conditions that cause explosions in gas transmission lines. Until recently there was no conclusive engineering evidence that explosions could occur underground. Recent information indicates that mild explosions have occurred in air-drilled wells. But the causes of these down-the-hole explosions may be different because:

- Air flow lines usually are jetted to the atmosphere.
- The existence of large quantities of dust in the explosive mixture during drilling.
- Possible presence of substantial quantities of moisture, which tend to suppress explosions.
- In general the velocity and turbulent flow conditions found in an air-drilled well are different from those found under pipe line conditions.

Causes of pipe line explosions . . .

Q. *What are the conditions which are conducive for explosions in gas transmission pipe lines?*

A. H. L. Stowers, chief engineer, Texas Gas Transmission Corporation, reports that experiments have been conducted which prove that detonation can occur in a natural gas pipe line under certain specific condi-

tions. In reports of experiments it was concluded generally that violent explosions could occur under the following conditions:

- Composition of gas-air mixture must be in the approximate range of 8 to 12 percent by volume natural gas in air.
- Ignition must take place within approximately ten feet of a reflecting surface, such as a restriction or closed end of a pipe.
- Linear velocity of gas-air mixture must be in the range of turbulent flow.
- The amount of combustible mixture must be large.

From these experiments it was concluded that the above conditions can be produced in natural gas pipe lines above four inches in diameter and that, on ignition, detonation will occur. Additional experimental work is needed on large diameter pipe lines in order to determine all of the conditions under which violent explosions can occur. Because of the lack of knowledge in this field, unsafe practices are being used in some instances and at the same time many unnecessary precautions may have been taken.

Some of the common sources of ignition are: flames (including matches), cigarettes, burners, incinerators, burning materials, sparks (including static electricity shorts), sparks from tools, heated materials (including hot metals), cinders, filament, and electric lights.

Elting Henderson reported in a paper presented at the 1941 meeting of the Pacific Coast Gas Association that composition of gas-air mixtures causing explosions varies from 6.5 to 12.6 percent.

Bottom hole fires . . .

Bottom hole fires have occurred in wells drilling with air in Pennsylvania and Utah. The damage done by these underground fires was negligible, except that the bottom drill collars were charred and sometimes fused to the bit.

In most instances the fires were fed by the oxygen from the air compressors and the process compares to the in-situ process used in secondary recovery. When oxygen was cut off fires were killed.

Precautionary measures . . .

Q. *What precautions have been taken to avoid underground explosions when drilling with air?*

A. A number of companies feel that there is a remote possibility that underground explosions will do sufficient damage to warrant the expense of special equipment necessary for the suppression of explosions. Several companies, however, have attempted to use nitrogen or another form of inert gas to minimize explosive hazards.

Exhaust gases. Exhaust gases from drilling and compressor engines have been used after being passed through heat exchangers and separators as shown in Figure 13. The idea being that the combustion gases would unite with the oxygen supplied by the compressors, forming water and a low oxygen content air-exhaust gas which would tend to minimize the possibility of a combustible mixture when a gas zone was encountered. The flow diagram is shown. Drilling results have been favorable.

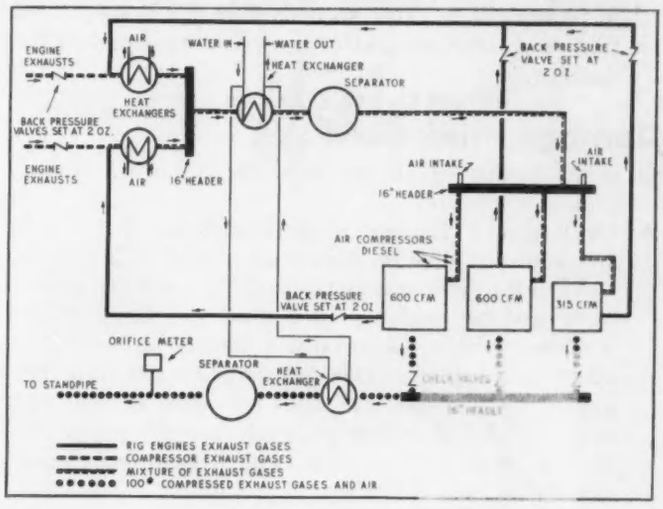

FIGURE 13

Aerated mud. Several companies believe that aerated mud will reduce the explosion hazard.

Underground explosions . . .

Q. *What experience has the industry had that indicates that the dangers from down-the-hole explosions are not dangerous?*

A. At least two underground explosions have occurred during the last two months. There have been as many as three underground fires.

- **In Wyoming,** an explosion occurred after the exhaust line was closed inadvertently. Prior to the explosion the pressure had been built up to 750 psi. As drilling proceeded, the operator was pressuring-up from 275 psi to 350 psi when the explosion took place. Moderately small damage was done at the surface. Reports are that the kelly jumped up one foot and sat down. The rig windbreaks were blown down, and the flow line valve was blown out. The air temperature was relatively high. No underground damage was evident. Operator is not discouraged. (Most experts feel that this would not have happened if the system had been open to the atmosphere.)
- **In West Texas,** while completing an oil zone by reverse air circulation, one operator experienced what is believed to have been a fire and an instantaneous explosion. A compressor without an aftercooler was used, and it is thought that the high temperature caused the discharge hose leading from the compressor to the standpipe to fail, forcing a small piece of the smoldering rubber into the annular space. White smoke was produced out the discharge pipe. Fire apparently did not last long because discharge pipe was not hot. Drilling proceeded and sample cuttings showed heavy oil and coke.

When the bit was pulled, it was found that the bottom hole drill collar had a one-quarter inch welder's groove through the diameter of the pipe for an eight-foot length.

Ordinance tests on the collar and slag deposits revealed that a temperature of 2700° F. would have

to be present to cause such damage. It is speculated that sand laden air and/or fire could have caused the damage.

Damage minimized . . .

Q. *What do the experts say about the damage of underground explosions?*

A. Dr. Eugene F. Poncelet of Stanford Research Institute answered this question. Reference is made to Figure 14.

As to the damage underground that could be caused by a methane explosion in a drill hole, Dr. Poncelet is of the opinion that no direct damage to the equipment can result in view of the comparatively low pressures developed. He does not wish to rule out, however, the possibility although not the probability of damage to the hole itself, which could conceivably jam the equipment.

As to the damage near the surface due to such an explosion, Dr. Poncelet says that the explosion itself is hardly likely to do damage to the surface equipment. But he does not rule out the possibility of the explosion setting the well on fire.

He questions the applicability of gas line failures to this problem. The phenomenon of gas line failure is not necessarily brought about by a detonation, Dr. Poncelet explains, but by a failure in the steel pipe, the fracture being self-propagating because it tears up the pipe at a faster rate than the pressure in the pipe can be relieved. Dr. Poncelet finds no parallel condition in the case of a methane detonation in an oil well.

Q. *What optimum detonations pressures are to be anticipated as a result of underground explosions?*

A. Figure 14, prepared by Dr. Poncelet, illustrates that the maximum pressure to cause the most damage could occur with 9.5 percent methane in air which is considered optimum. This methane-air mixture would result in a gas pressure at the detonation front of 52.6 atmospheres or 773.22 psi pressure. This is represented by the point P_1 on the curve. Many experts believe this will have a short reaction and will result in minimum amount of damage. There are pressures in the bore hole greater than this figure, yet do no great destruction.

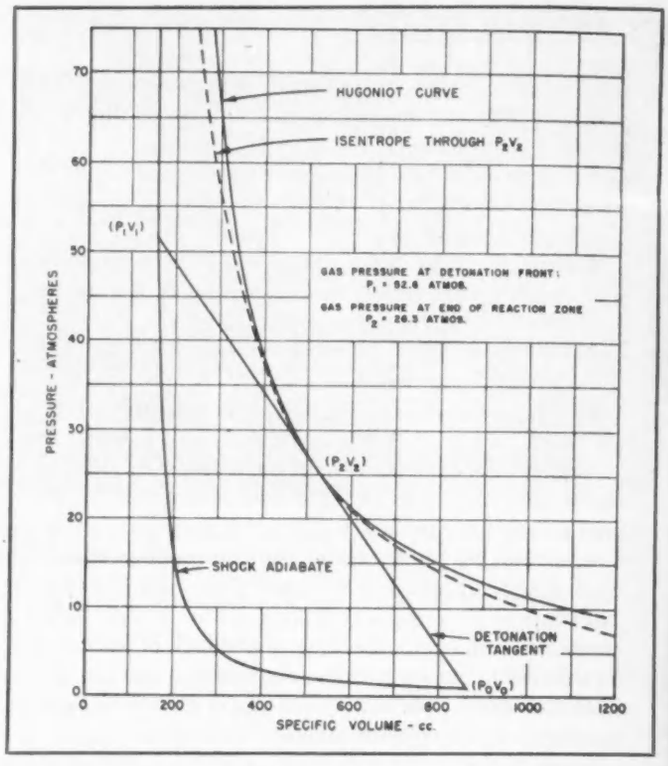

Fig. 14—Detonation curve for 9.5 percent methane in air at 70° F.

The pressure given above is the pressure of a plane (flat) detonation pulse. A spherical, or expanding pulse have lower pressures.

A number of companies are known to have drilled in the explosive range of from 5 percent to 15 percent methane in air, for as many as 15 to 20 days without an explosion.

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Q. *What rates of mud (water) flow are circulated for drilling with an aerated column?*

A. The mud (water) circulation rate, generally speaking, can be decreased as air rate is increased. The statement in Answer 1, above, is predicated upon a mud (water) rate of 50 gallons per minute or less in an eight-inch hole. No experience is available at mud rates this low.

Q. *What precautions need to be taken regarding corrosion when drilling with an aerated column?*

A. Drill pipe corrosion can be extremely rapid under certain conditions. Saturated lime water has proved effective in controlling corrosion thus far. Apparently high pH is the most important factor. Flow line mud temperatures above 130° F. have not yet been observed.

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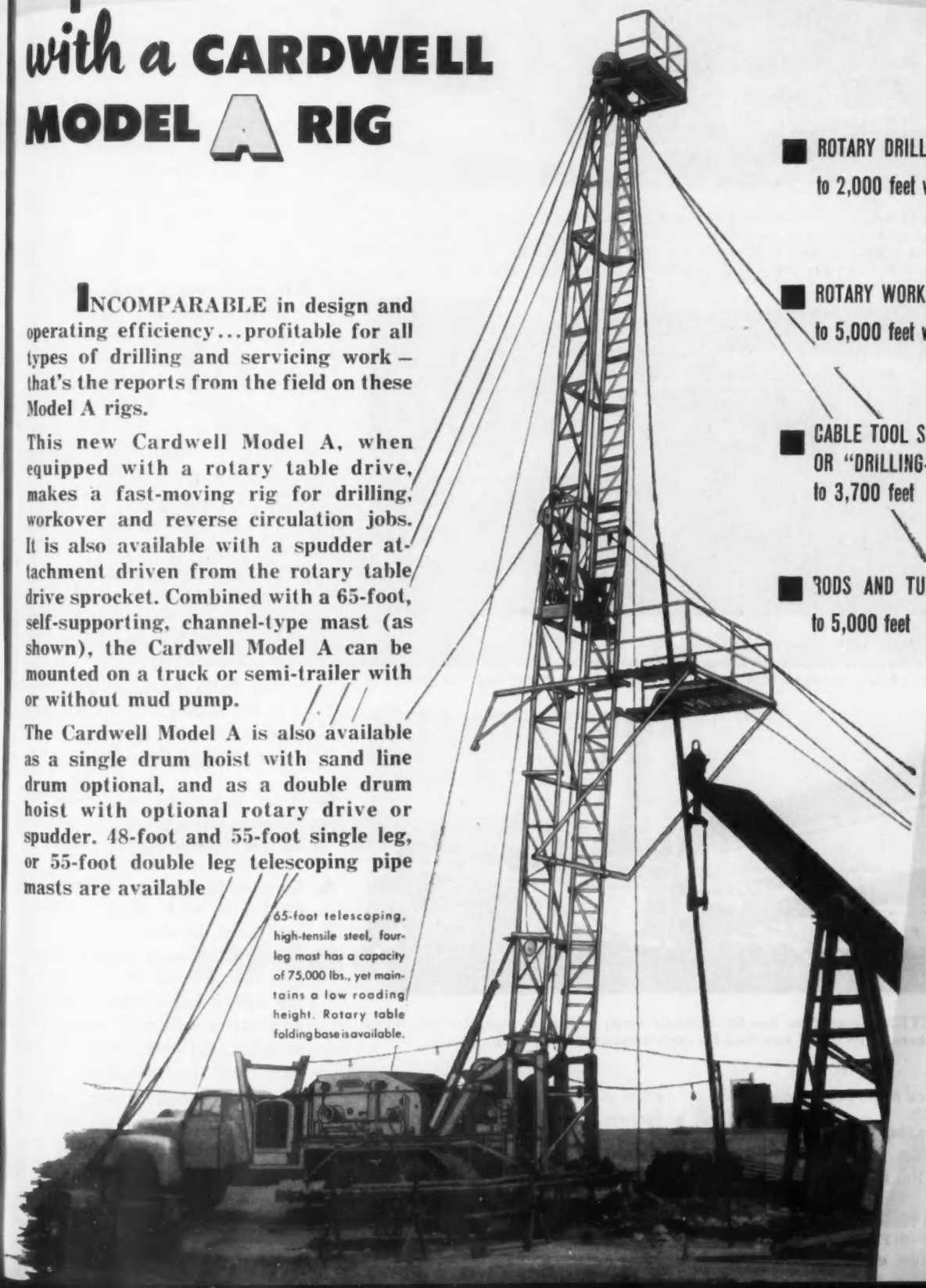

65-foot telescoping, high-tensile steel, four-leg mast has a capacity of 75,000 lbs., yet maintains a low roading height. Rotary table folding base is available.

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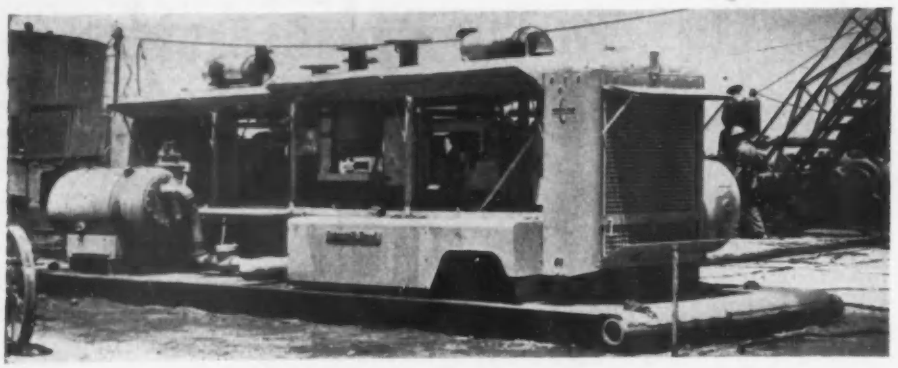
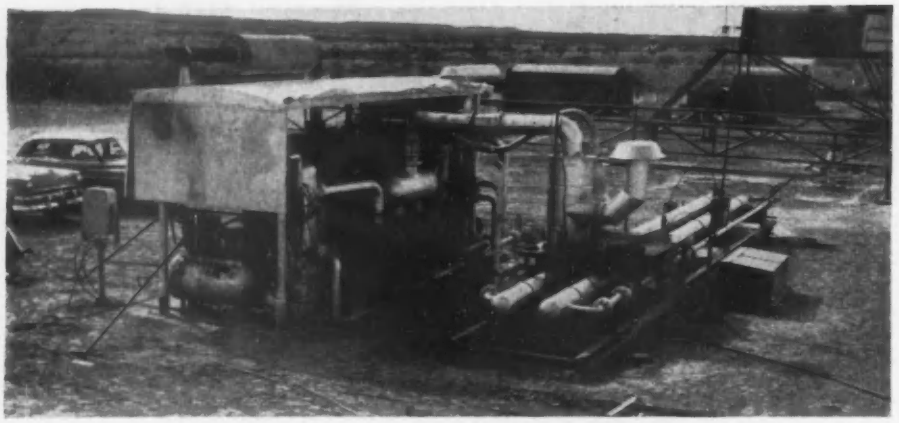
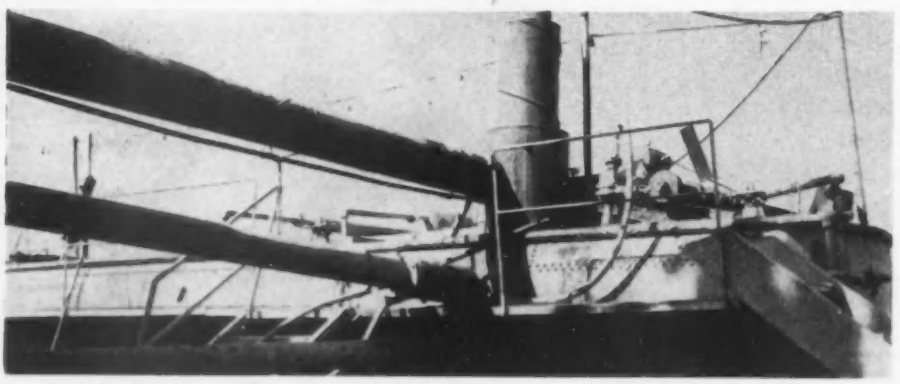


DUAL-MOUNTED rotary type compressors rated at 600 cubic feet per minute at 125 pounds per square inch have been used for air, exhaust gas, and aerated mud drilling when supplemented with a booster ccmpressor capable of pressures to 850 psi and above Water columns have been aerated giving substantial increases in penetration rates.



ONE MAJOR COMPANY uses a 220-horsepower four-cycle package compressor to aerate mud. In addition to the V-type compressors, the package includes an inter-cooler and after-cooler shown at right and automatic control and recording equipment.



LARGE-DIAMETER return flow line for mud-air (top) and mud separator are shown here. Line below was used for conventional mud drilling.

Q. *Have crooked holes been indicated?*

A. No increased tendency toward crooked holes has been encountered with the air-mud ratios used

nent of aerated mud, stated these factors had not been altered. It is possible, but not anticipated, that it will be necessary when using higher air-mud ratios than have

be greater as weight on the bit is increased.

Q. *What are the requirements for handling fluid flows from the well bore?*

A. There are several requirements for handling air (gas)-liquid mixtures from the well bore:

- A rotating head of some sort must be used to confine the mixture at the surface and deflect it to the flow line. This head need not withstand more than 25 psi as an absolute maximum, and the operating pressure ordinarily ranges from ½ to 2 psi.
- A low-velocity space must be provided to allow separation of the gas and liquid phases. An oversized flow line is highly desirable. Even with the large flow line, baffling or flow deflection must be provided at the mud box to control velocity heading. This is essential but not difficult.
- If combustible gases are being used for aeration, or are present, it is advisable that the gas phase be transported away from the rig site for venting. To accomplish this, a separation chamber with liquid seal can be provided ahead of the mud box. The mud then flows through the seal area to the shaker and the gas phase flows from the top of the chamber through the vent line.

Q. *What experience has been indicated by the industry in blocking off fluid flows?*

A. One company encountered two fluid flows while drilling with aerated mud. In the first, no loss occurred when aeration was stopped and the zone was sealed by drilling with a low viscosity, bentonite and native solid mud. Subsequent aeration did not result in fluid gain from the formation.

In the second case, complete loss occurred when aeration was stopped. It was possible to "balance" the zone while drilling by

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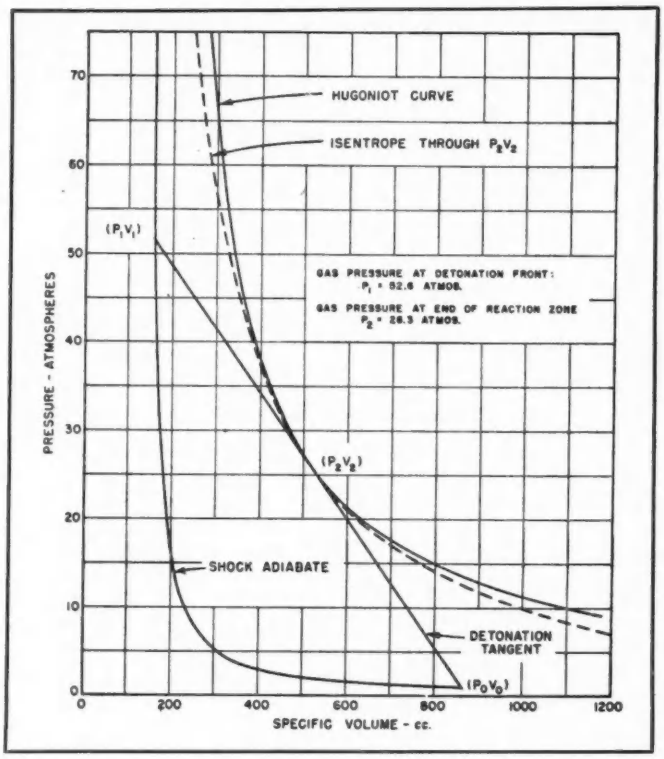

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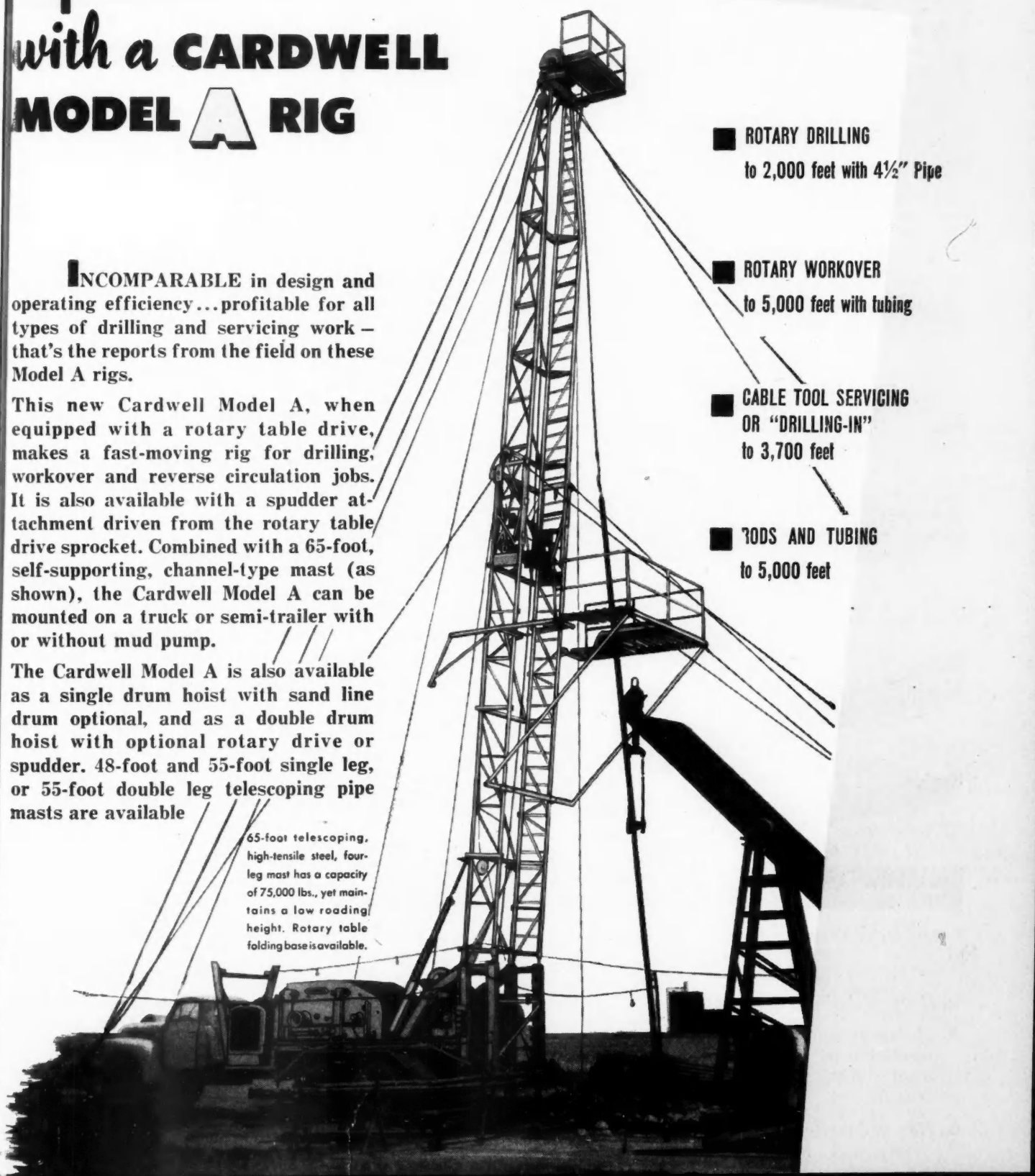

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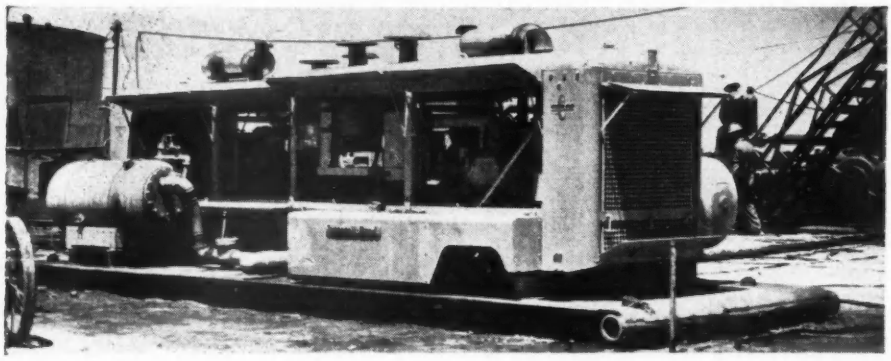
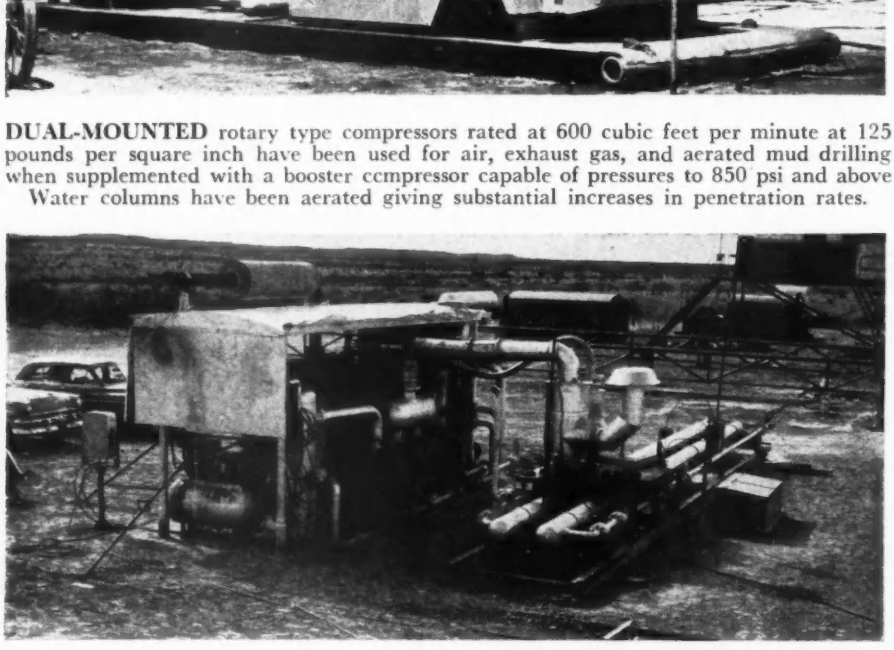
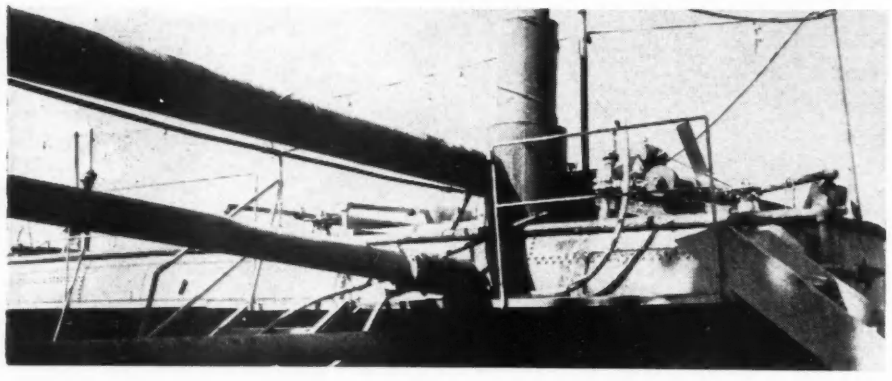
THERE IS A CARDWELL PARTS STOCK NEAR OR IN EVERY OIL FIELD OF THE WORLD



DUAL-MOUNTED rotary type compressors rated at 600 cubic feet per minute at 125 pounds per square inch have been used for air, exhaust gas, and aerated mud drilling when supplemented with a booster compressor capable of pressures to 850 psi and above. Water columns have been aerated giving substantial increases in penetration rates.



ONE MAJOR COMPANY uses a 220-horsepower four-cycle package compressor to aerate mud. In addition to the V-type compressors, the package includes an inter-cooler and after-cooler shown at right and automatic control and recording equipment.



LARGE-DIAMETER return flow line for mud-air (top) and mud separator are shown here. Line below was used for conventional mud drilling.

Q. *Have crooked holes been indicated?*

A. No increased tendency toward crooked holes has been encountered with the air-mud ratios used thus far.

Q. *How do rotary table speeds and weights using aerated mud compare with conventional mud drilling?*

A. One company, a leading proponent of aerated mud, stated these factors had not been altered. It is possible, but not anticipated, that it will be necessary when using higher air-mud ratios than have been used. It is anticipated that the difference between aerated mud drilling and conventional mud drilling with respect to penetration rates for dolomitic limestones and other hard rocks will be greater as weight on the bit is increased.

Q. *What are the requirements for handling fluid flows from the well bore?*

A. There are several requirements for handling air (gas)-liquid mixtures from the well bore:

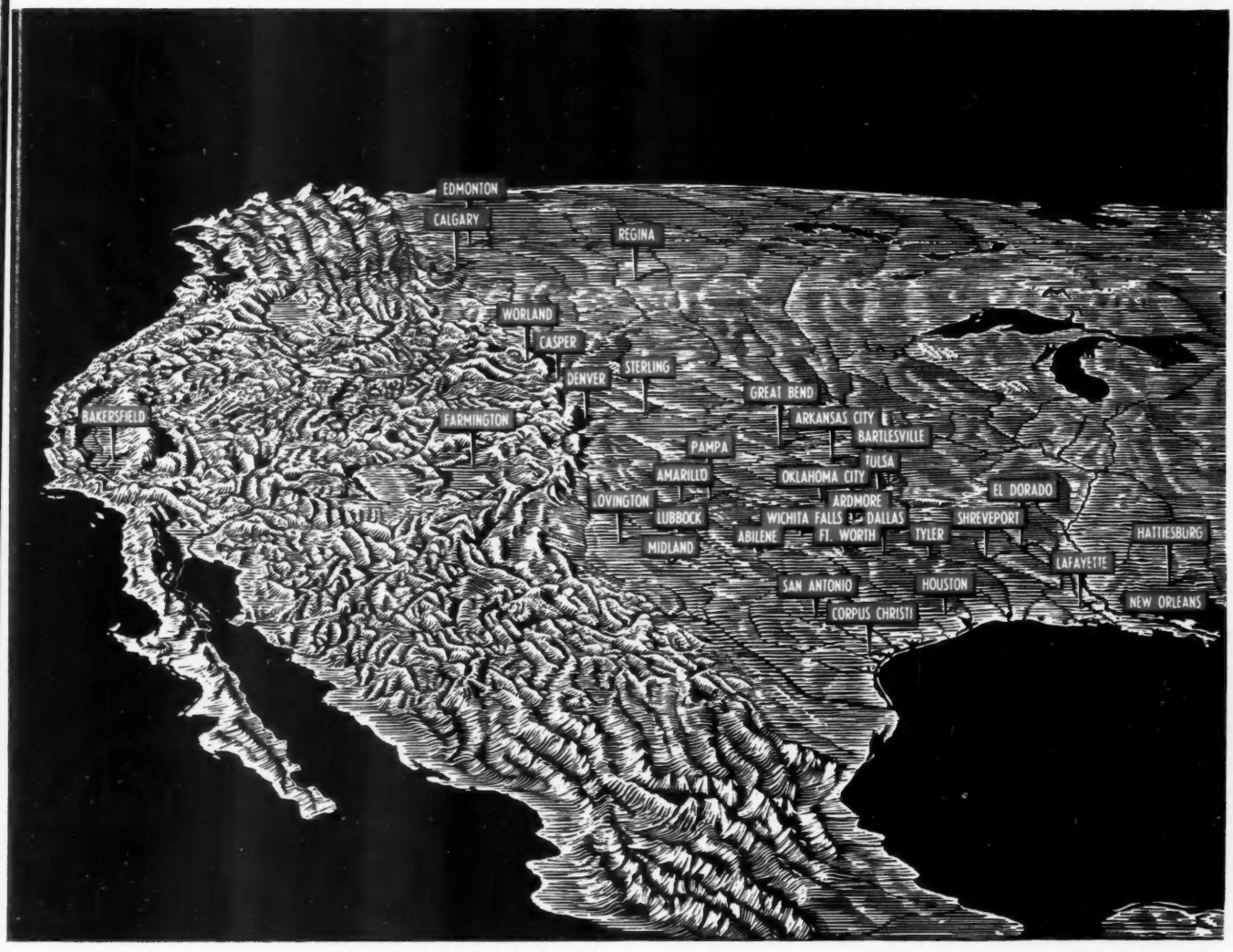
- A rotating head of some sort must be used to confine the mixture at the surface and deflect it to the flow line. This head need not withstand more than 25 psi as an absolute maximum and the operating pressure ordinarily ranges from ½ to 2 psi.
- A low-velocity space must be provided to allow separation of the gas and liquid phases. An oversized flow line is highly desirable. Even with the large flow line, baffling or flow deflection must be provided at the mud box to control velocity heading. This is essential but not difficult.
- If combustible gases are being used for aeration, or are present, it is advisable that the gas phase be transported away from the rig site for venting. To accomplish this, a separation chamber with liquid seal can be provided ahead of the mud box. The mud then flows through the seal area to the shaker and the gas phase flows from the top of the chamber through the vent line.

Q. *What experience has been indicated by the industry in blocking off fluid flows?*

A. One company encountered two fluid flows while drilling with aerated mud. In the first, no loss occurred when aeration was stopped and the zone was sealed by drilling with a low viscosity, bentonite and native solid mud. Subsequent aeration did not result in fluid gain from the formation.

In the second case, complete loss occurred when aeration was stopped. It was possible to "balance" the zone while drilling by controlling the air-mud ratio. The zone was later sealed with fibrous material and viscous mud, but this seal was removed when air was subsequently injected.

Q. *What are the relative merits of*



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"mudding up an air column" or "aeration of a mud column"?

A. The term "mudding up an air column" refers to a method of achieving an aerated mud column, it would seem that it must be assumed that it can only be done once. The circulation of air (gas) alone, as practiced now, requires little circulating pressure compared to aerated mud drilling techniques. The addition of mud would require only the maximum pressure required during stabilized drilling.

To again circulate air alone would probably be impractical, possibly from the standpoint of pressures required to unload the hole of all mud and certainly from the standpoint of drying the hole. It follows that after an air column is "mudded up" in the above sense, subsequent drilling will be aerated mud and/or conventional mud to the exclusion of drilling with air alone.

The "aeration of a mud column" requires a maximum of pressure at the time the first aerated mud is passing the bit. No unique "conditioning" of the hole is necessary, and the mud will have been conditioned while drilling before the gas phase is introduced.

Q. *How long does it take to stabilize an aerated column?*

A. The time to stabilize an aerated column depends upon depth and rates of gas and mud injection. When aeration is started in a system circulating liquid, stabilization time may approach two hours at 10,000 feet.

Q. *What are the safety advantages of aerated mud?*

A. Compared to air or gas alone, aerated mud has the following safety advantages:

- Conditioned mud is constantly being circulated in readiness for an emergency.
- Quick weight buildup can be obtained by cutting off the air and throwing the annular returns through choke lines. The resulting compression of gas in the annulus effects an extremely rapid buildup of annular weight.
- In the event gas is encountered while drilling with an air-mud mixture, the danger of a downhole explosion is infinitely less than when drilling with air. The mud both saturates the gas phase with vapor and absorbs heat so that it is generally agreed that combustion literally cannot be supported down the hole.
- The liquid phase reduces the amount of gas that leaks around the drilling head by blocking spaces between moving parts.
- Being constantly conditioned to mud there is less danger of the hole sloughing in event a wet zone is encountered.

Q. *Discuss the practical considerations for using aerated mud.*

A. As far as the function of mud as a weighting agent is concerned, the need varies from none to apparently more than 18 pounds per gallon. In the past, fluids in use were either a gas or a mud weighing between 7 and 20 pounds per gallon, leaving a considerable gap of weight range totally unused. **It would seem logical that the minimum possible fluid weight should be used to effect penetration rate,** while maintaining a degree of safety. Following the above line of reasoning, there is no competition among a gas, aerated mud, and mud. Rather, there is an intermediate tool added by the innovation of aerated mud. The extent to which aeration can be applied remains to be seen. When air or gas cannot be used, mudding up must take place. There is no further choice. Technique from that point on would consist of aerating a mud column or drilling with mud.

Several major companies feel that aerated fluid drilling techniques hold greater potential for controlled drilling than does air or gas drilling at this stage. It cannot be stated categorically that straight air or gas drilling will disappear entirely.

Q. *What compressor pressure ratings are desirable for unloading a mud or water column?*

A. See answer to first question on aerated mud in this report. The maximum pressure discussed there was for the purpose of "going around bottom" or unloading. It can be done with less, but not with confidence nor as quickly as desired.

Q. *What size mud pumps are used for the injection of fluid when aeration technique is used?*

A. The size of pumps is dependent upon several other factors. If speed is constant, pumps smaller than 5-inch by 12-inch duplex may be necessary. More desirable would be large pumps with flexible speed control. This is purely a mechanical problem, but remains to be worked out.

Q. *If a well encounters water flows of 100 barrels per hour, will it be economical to plug-off and drill with air?*

A. It appears that water shutoff must be by conventional squeeze techniques, but possibly with relatively new materials. The plugging must occur within the zone and not be a plastering effect against the hole wall.

Economics are unknown. It would quite likely be possible to plug and use aerated mud, depending upon permeability and probably the cost and effectiveness of shutoff.

Q. *What volume of fluid from the well can be tolerated?*

A. The volume of fluid that can be tolerated depends upon the character of the fluid, depth, and storage space. For instance, at 7000 feet, probably 100 barrels per hour of fresh water could not be tolerated because of inhibitor loss. At 500 feet, it would be a minor problem. If it were sulphur or salt water, it would be prohibitive to handle and could not be turned loose or used.

NEXT MONTH

Part 4 of the Series on Modern Drilling Technology by Roy A. Bobo, Robert S. Hoch and George S. Ormsby will appear in the Drilling Section of the March issue of WORLD OIL.

Rockwell-Built

MUDWONDER

Cuts High Maintenance Costs to Zero IN JET SERVICE ON DELTA GULF RIG No. 5

"We have drilled 45,000 ft. of hole since equipping our jet guns with 2 in. MUDWONDER mud valves," says Toolpusher W. M. (Mack) Ault. "These valves have been in constant service, operated under extreme pressures on fluids containing as much as eight per cent sand and at times as much as 12 lb. per barrel lost circulation material. They have required no maintenance and have operated with ease at all pressures."

The cost of maintaining mud valves, especially the jet or mud gun valves, had reached an alarming figure on the Delta Gulf Drilling Company Rig No. 5 working in the Lake Charles, Louisiana, area. According to Mack, MUDWONDER valves are just what has been needed for a long time in the oil field to help reduce operating costs.

Is it any wonder Mack's crew feels MUDWONDER valves can cure any mud valve problem? MUDWONDER has licked their worst.

On standpipes, jet guns, pump discharges, whatever your troublesome service is, you will cut costly down-time and part replacement with competitively-priced MUDWONDER mudline valves. Ask your favorite supplier or use the coupon below for complete details, today.

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Send me your latest MUDWONDER catalog and price list for 3000 psi WP (6000 psi test) and 2000 psi WP (4000 psi test) mudline valves.

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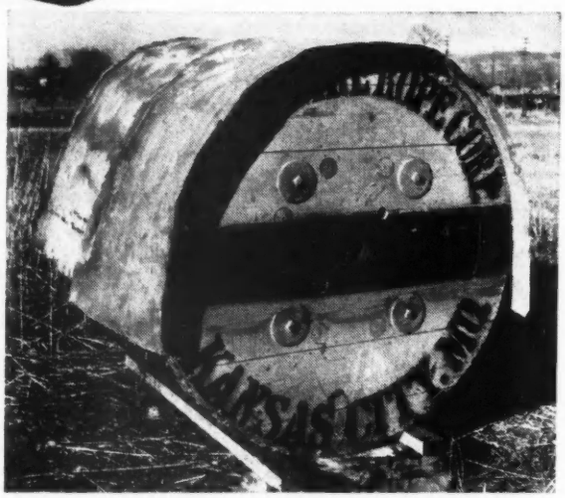
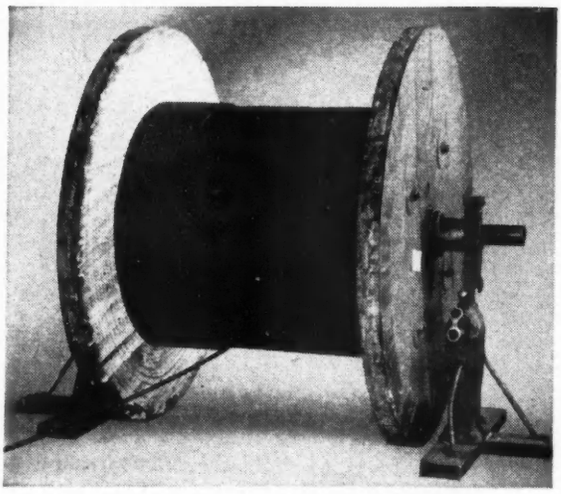
Tuffy® tips on getting e



Store Rope Like This

Keep spare rope in a dry, sheltered place free of dust, vapors or fume-laden air. If stored out of doors, set reel on blocks off the ground. Clear away weeds and grass and protect with a waterproof covering as shown. Check each month for rust caused by moisture collecting on the rope. Paint with a heavy crankcase or cylinder oil if rust is discovered or even before it shows up if moisture is present.



Unwind Like This

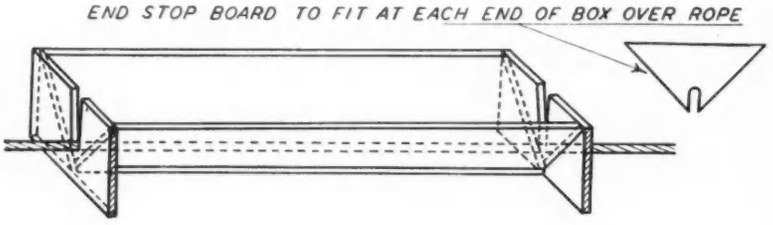
When getting ready to install the rope, special care should be taken to see that the reel is set up for smooth, easy unreeling. Set reel up on jacks as shown above and unreel so the rope pulls off from the bottom of the reel—*not* from the top. Coils should be put on a swift or rolled on the ground to pay off the rope. Kinks or "doglegs" may result from incorrect unreeling, seriously damaging wires of the rope and greatly reducing the ultimate life.

Always Keep Rope Lubricated

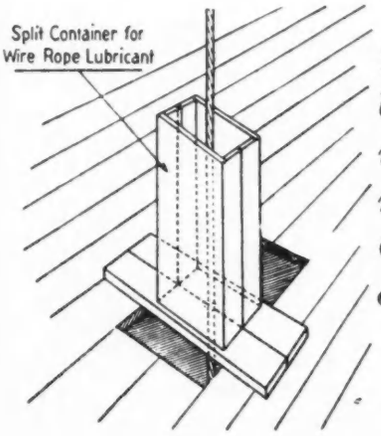
Rope That Is Stored for long periods of time should be lubricated during installation. If it is not possible to lubricate stored rope very often, apply a sealing compound to hold the lubricant that is already present.

Rope In Use can be lubricated most economically without removing it from the equipment on which it is operated. Lubricate rope as often as it needs it—service conditions determine the frequency.

Use Lubricant Hot or Cold, depending on its penetrating qualities. Your local oil company engineer will be able to recommend an oil that will actually penetrate to the working parts of the rope, and not just form a coating that peels off the first time your rope runs through a sheave.

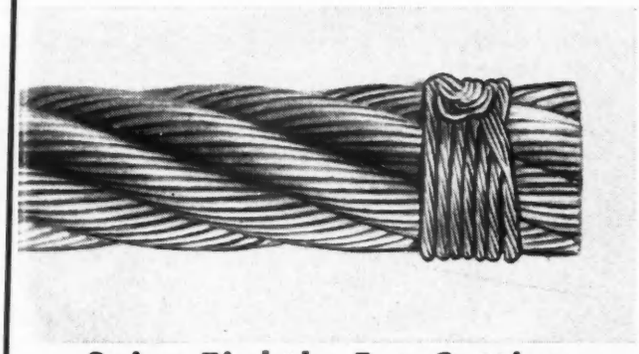


Two Home-Made Oiling Devices



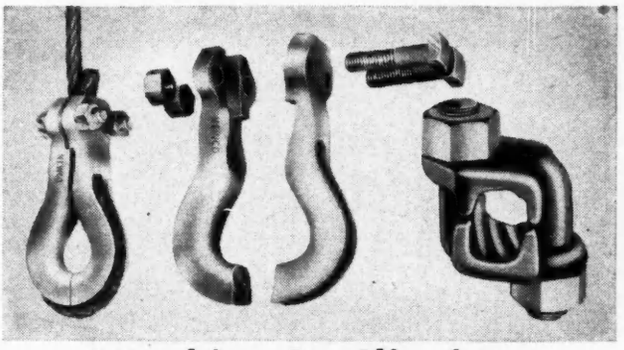
These two oiling devices can be used without removing the wire rope from the equipment on which it operates. One is for vertical ropes, the other for horizontal ropes.

ngextra service from *Wire Rope*



Seize Tightly For Cutting

Cutting can throw the strands out of fabricated position and, in time, result in kinks or doglegs. Seizing the rope securely before cutting, as shown above, assures that no movement of the strands can occur when you make cuts. Because most ropes are now preformed, and stress free, only one seizing wire at each side of the cut is needed.



Attaching By Clipping

The fittings you use on wire rope can handicap it or enable it to work at full efficiency. Fittings which derive holding power by crimping action are harmful to the rope. Shown here are two rope clamps. One is a combination clamp and thimble. Both provide snug saddling of the rope and grip larger and uncrimped bearing surfaces so tightly that the loads are carried almost solely by the force of friction.

Available To You: The *Wire Rope* Experience of Specialists

Working with users to whip wire rope problems has provided Union Wire Rope engineers a wealth of on-the-job experience. Out of this priceless experience has come a family of wire ropes for special purposes. Into them is put the grade of steel, the rope construction and operating characteristics which laboratory research and field development have proved best for the particular purpose for which made.

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Tuffy Rotary Lines

Ton-Mile Indicator and Log Book. Provides you with a slide-chart method for figuring ton-miles quickly and easily, and with it you get a log book for your ton-mile record.

Cut-Off Practice Book. Outlines the quick, easy way to tell when to cut-off and how much. Shows how to obtain maximum service from rotary lines and avoid cutting too much, too soon or too little too late. Carries cut-off tables for derricks of all heights with the various draw works operating in all the major oil territories.

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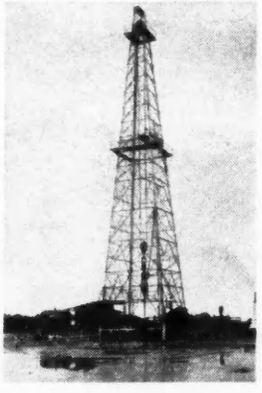
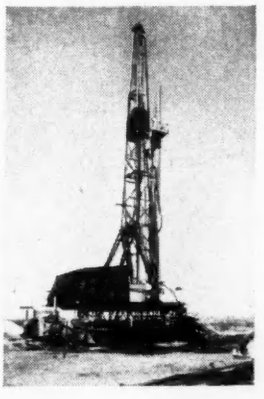


Standard...

Spools easy, runs longer without cutting and crushing. Also tops for deep drilling beyond 7000 ft., where a jackknife rig is used, especially where large drill pipe with many drill collars is handled.



Or Jackknife

Extra flexible for best possible spooling and reeving on jackknife sheaves and drums. Yet strong enough to resist severe wear during the routine hoisting of the drill pipe stem. For depths to 7000 ft.

Your Tuffy Distributor Works to Learn Your Business

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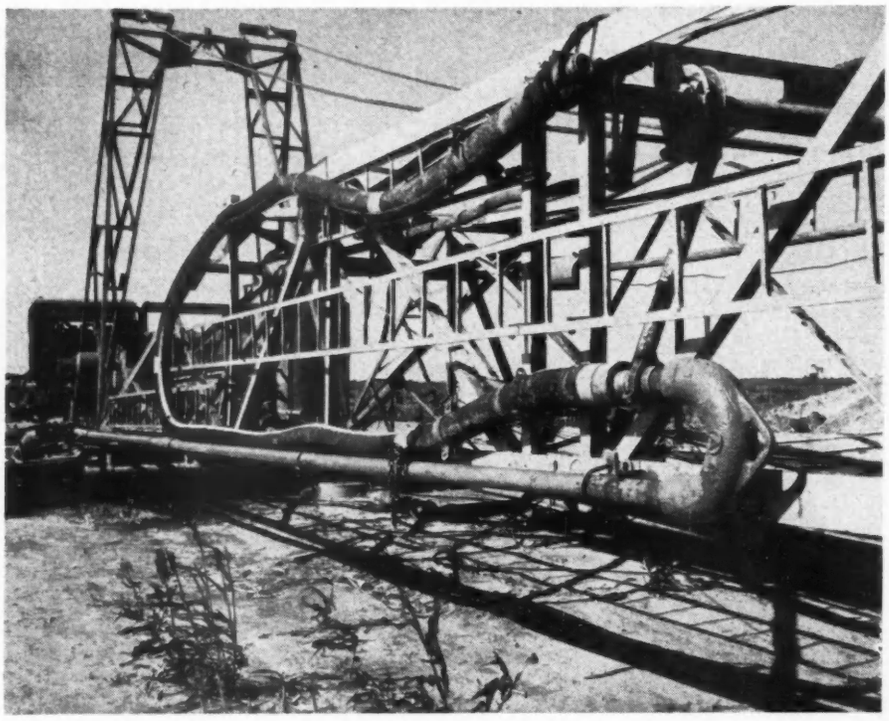
How to do it

DRILLING HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.



Rotary Hose Is Moved on Derrick Side

On jackknife derricks, the rotary hose can be transported as shown. The standpipe can be fastened to the derrick so that when it is raised, the foot of the standpipe just touches the flange to which it is attached and the lower end will give enough so that it can be made up.

When it is time to tear down, the flange can be broken out, the rotary hose disconnected from the goose neck at the hammer head union, and the rotary hose tied neatly back along the outside of the derrick framework where it is well protected. This necessitates breaking only two quick acting unions when the rig is to be taken up or down. These unions are easily made up again when the rig is re-assembled.

This suggestion saves considerable rig-up time.

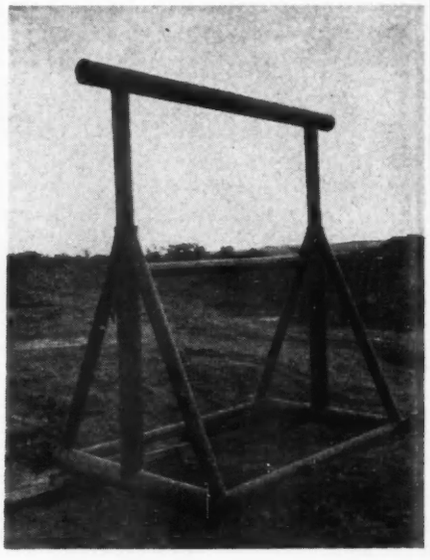
Make Pipe Support Adjustable to Terrain

When it is necessary to lay down the jackknife derrick on uneven ground, a mast support which is adjustable to the terrain may be made from scrap steel materials around the contractor's yard.

First, make a frame three feet by six feet out of four-inch pipe. At the midpoint of each end piece, weld a five-foot long upright out of five-inch pipe. Weld four-inch pipe braces on each side.

Set two lengths of four-inch pipe six feet long, to slide or telescope inside the five-inch uprights and center them so there is equal clearance around the pipe. Weld a cross member made of five-inch to the extremities of the four-inch. After cooling, the assembly should be tested to see that the pipes will slide freely inside the five-inch pipe.

Next, with a welding torch in hand, raise the cross member one foot and burn holes through the telescoping pipe as shown to admit a three-fourths-inch pine. Raise the member another foot and burn holes inside the four-inch riser on each side. Do this

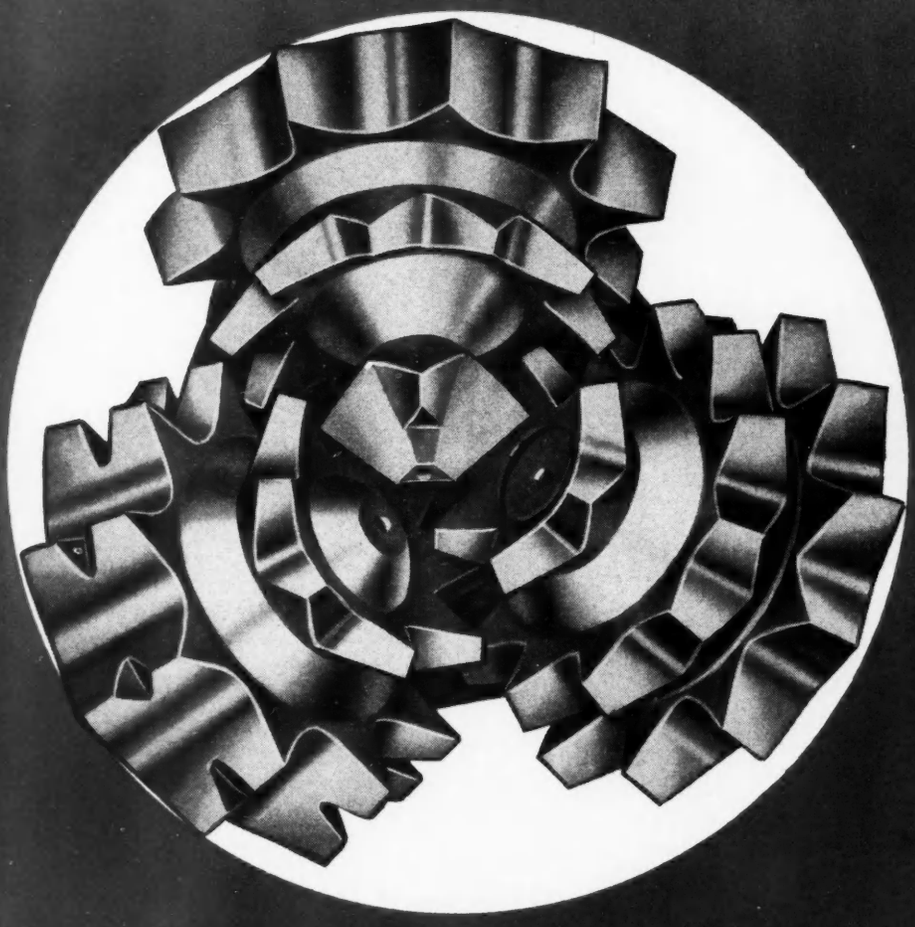


until only a foot remains inside the five-inch. Now attach a short piece of chain to the end of the pin and the five-inch riser on each side by welding and the assembly is ready to take to the field.

Ice Tongs Can Be Used As Handy Filter Puller

Earl J. Perilloux, engine man on a drilling barge, suggests that ice tongs can be used as a lube oil filter puller to save time and sore backs on any power rig now in use. This hint saves money by preventing lint, string, etc., (depending on whatever goes into the making of the different oil filters) from getting into the oil passages of an internal combustion engine. Frequently, oil filters will swell after they have been in use for awhile and de-

H.C. Smith 3-CUTTER ROCK BITS



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Wire Rope at Work—This is the drilling barge *Doc*, photographed at the edge of picturesque Sixmile Lake, Patterson, La. One of the finest, best-equipped barges ever built, it is owned and operated by Blackie Drilling Company of Franklin, La.

The *Doc* has a big, powerful drawworks equipped with 5,000 ft of Bethlehem Purple Strand rotary line—6x19 construction, 1¼-in. diam. This is strong rope, tremendously strong, and it enables the rig to handle very heavy strings of drill pipe. The wire rope is a key factor here, in one of the most demanding services known—a service where Purple Strand quality is always an assurance of efficient rope performance.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

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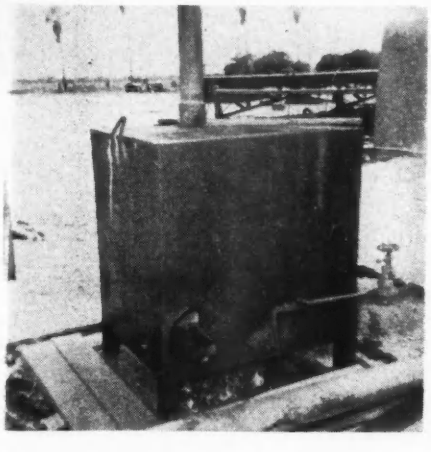
teriorate making them difficult to remove in one piece.

Perilloux says that an ordinary pair of ice tongs will dig into the sides of the filter so the operator or engineer can successfully remove the filter in one piece.

$10 Was Paid for This Suggestion

If you have ideas equally as good or better, send them in. We'll pay you $10.00 for your trouble. Just send us a picture or a rough drawing with a short description; we'll do the rest.



Gas Heated Blow Barrels Replace Steam Units

Many a pair of roughnecks' "greasers" have been washed in the old steam heated blow barrel—but steam

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Dependable
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MAGNET!
A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.
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This is not only the handiest way to correct a gauge; it is also the best way. Conventional methods of adjustment simply compensate for the error. The "Recalibrator" corrects the relationship between the movement and the bourdon tube—actually *does re-calibrate* the gauge.

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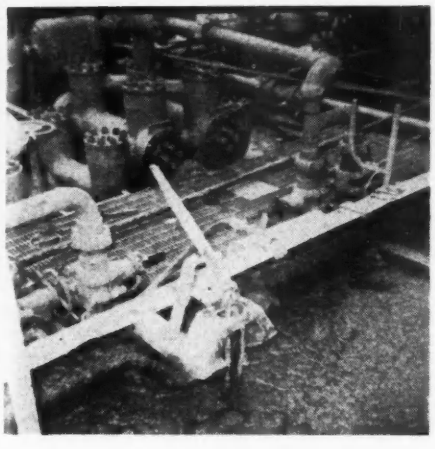
rigs are gradually being replaced by power rigs and something had to be done to preserve the "roughnecks washing machine."

Although they vary according to locale, contractor, etc., several types of gas heated blow barrels have appeared on power rigs which do an effective job.

One such unit used by a Gulf Coast contractor is shown. Constructed in the shape of a square tub with a top and bottom compartment, the blow barrel performs like its steam predecessor. The top compartment is for water. The bottom or fire compartment uses either a gas supply or trash to furnish the heat. A flue pipe runs up through the water compartment and out the top side. Clothes are placed in the tub through the square hole in the top. Water drain holes are cut in the side and are capped with small bull plugs.

Hooks welded to the barrel facilitate placement of equipment on location or during moves.



Diaphragm and Valve Regulate Mud Flow

On many rigs having steel mud tanks, the mud pumps are below the level of the mud in the tank.

If the mud pumps are to be torn down for repairing, some way is needed to keep the mud from flowing out of the tank.

A Gulf Coast contractor has hinged a rubber diaphragm over the pump suction hole in the mud tank. A linkage runs to the top of the mud pit and is connected to a lever which facilitates the raising and lowering of the diaphragm.

Frame-Shaped Ramp Aids Tractor Loading

George Baize, oil field dirt contractor of Hill City, Kansas, uses this homemade ramp to facilitate the loading of his tractor. Made from four-inch drill pipe, the frame is welded solidly to the truck frame except for the lower end which is hinged so it can swing down and rest on the ground.

The upper end is made of scrap drill pipe welded up in shape of window frames to accommodate the trac-

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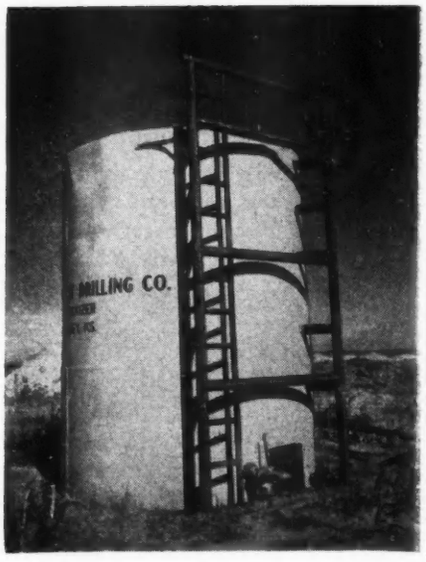
tor tracks. Note the well-braced frame is welded securely to the back of the truck frame. Sucker rod pieces are welded across the top of the horizontal track supports to aid traction.

The lower section is made up of two triangular shaped legs which have collars welded at the top which slip over the lower member of the upper frame before it is welded up. These members rest on the ground, but after the tractor is loaded, can be swung up so that the rear of the trailer is free of the ground when traveling over the road.

Skid-Ladder Combo Aids Tank Moves and Gaging

The Golden Cat Drilling Company of Waukeeney, Kansas, has constructed skids on the water tank to provide easy moves from one location to another. The skids project from the tank to protect piping connections on the bottom. On the left is constructed a ladder to facilitate inspection of the tank for gaging.

The side skid base is made from a frame of four-inch pipe with four cross members. The pipe is flush with



the bottom of the tank and extends three feet above the top. It is connected to the tank by means of six legs on each side which are welded to the sides of the tank.

The ladder is made by welding an extra two-inch pipe along the left side and making the rungs with two-inch cross members.

When it is necessary to move the tank, the tank is drained and a winch line connected to the top cross member by using the ladder provided. The tank is then pulled over on its side and then winched up onto the bed of the truck for easy moving. When it is spotted at the next location, it is pulled off of the truck and raised by means of the same tie on the top of the frame.

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Job Analyses Pay Dividends

More for your operation and maintenance dollar is what you get when you use this new technique.

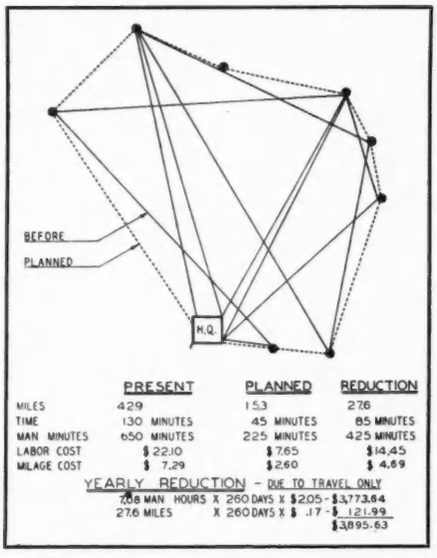
By **HAROLD S. KELLY and ROGERS C. FILSON,**
Phillips Petroleum Company, Bartlesville, Okla.

SUBSTANTIAL ECONOMIES have been achieved through time and methods studies of lease producing operations. As a result of this unique job analysis, adequate tools and special transportation units were designed and placed in service to improve the efficiency of the working force, lengthen the life of lease equipment and reduce downtime lost production.

It was found that the old general classification of pumper with broad duties including pumping operations, equipment servicing, and minor repairs could be advantageously replaced with a pumper classification limited only to operating duties on a greater number of wells, plus a properly equipped tune-up and service mechanic whose time would be devoted 100 percent to tune-up, servicing and preventive maintenance. This reorganization of lease operations resulted in lower total labor costs, longer life of equipment, and less lost production from downtime.

The regular lease surface maintenance roustabout work is also subject to organization, special equipment, and transportation units which permit a reduction in the cost of maintenance labor and improvement in the maintenance of the leases.

Time and methods studies of producing leases in several Phillips Petroleum Company districts were used as a basis for designing operating and maintenance jobs and for determining labor requirements, tools and automotive units needed to more efficiently perform these jobs. Follow-up methods studies were made after the jobs, methods, tools, and automotive units had been redesigned to determine whether the planned savings had actually been effected.



	PRESENT	PLANNED	REDUCTION
MILES	429	153	276
TIME	130 MINUTES	45 MINUTES	85 MINUTES
MAN MINUTES	650 MINUTES	225 MINUTES	425 MINUTES
LABOR COST	$ 22.10	$ 7.65	$14.45
MILAGE COST	$ 7.29	$ 2.60	$ 4.69

YEARLY REDUCTION - DUE TO TRAVEL ONLY
268 MAN HOURS X 260 DAYS X $2.05 - $3,773.84
276 MILES X 260 DAYS X $ .17 - $ 121.99
$3,895.83

Fig. 1—Five-man maintenance crew travel chart. Solid line indicates route prior to analyses. Dotted line shows route as result of reorganization of job duties.

Three broad categories of work are covered as they were delineated by the methods studies; namely (1) Operations, (2) Tune-up and Preventive Maintenance, and (3) Field Maintenance and Repair. Each broad classification of work is discussed separately with respect to:

1. Job functions.
2. Reorganization and design of the job and resulting savings.
3. Major tools and equipment needed for the redesigned work.

Observations from initial studies. The initial methods studies revealed:

1. Lack of organization and planning of lease work.
2. Inadequate tools and equipment for efficient execution of the work.
3. Travel between jobs consumed a significant amount of time for both lease operations and for maintenance. For the pumper, travel time consumed from 25 to 50 percent of his total time and for the maintenance work travel time consumed from 40 to 60 percent of the total time. (See Figure 1 which shows maintenance crew travel distances before and after methods studies and job-design.)[1]
4. Where pumpers are paid "car-allowance" for furnishing their personal car for transportation, it is difficult to secure a transportation unit suitable to carry all the tools and equipment needed for the job.
5. Preventive maintenance work is usually not performed effectively and faithfully by the pumper.
6. For over 90 percent of the maintenance work, the most efficient

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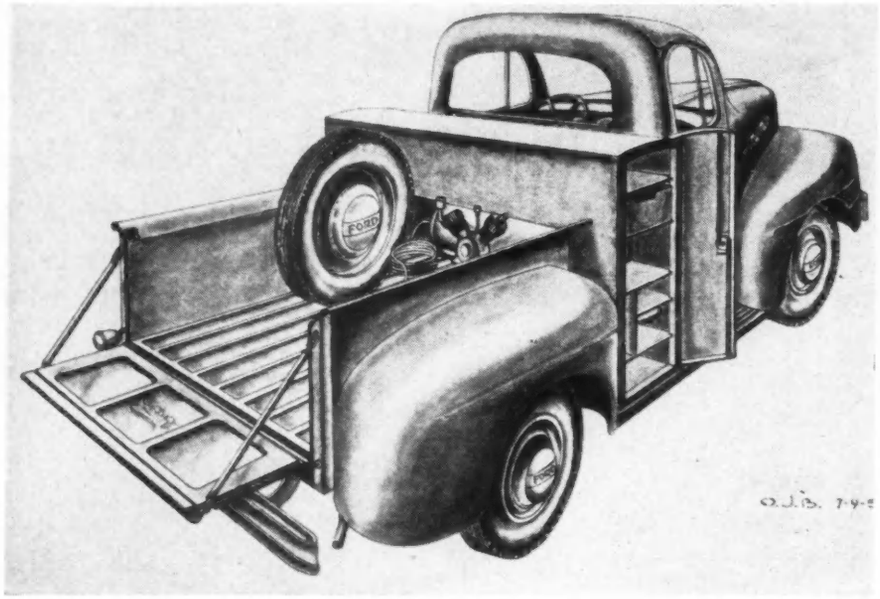


SPECIALLY-DESIGNED pumpers transportation unit under new plan.

and economical size of crew is two men properly equipped. Laying of lines or installation of new equipment require more men but this work usually can be handled temporarily by combining two small crews or by letting it to contractors.

The pumper classification. The lease switcher or pumper usually is required to flow or pump the wells to obtain the lease allowable, gage the production, treat the oil, and arrange for the sale of crude to the pipe line. He checks the separators, treaters, and production lift equipment to see that they are functioning properly. He lubricates the equipment, makes minor adjustments, and keeps the lease clean.

FIGURE 2
Pumper's Transportation Unit

Approximate Cost and Load Capacity:		
½ Ton Pickup w/Box Bed...	$1,781	
Special Body.....	244	
Special Air Starting Equip...	450	
Tools.....	70	
Total.....		$2,545
Estimated Approximate Average Miles per Day.....		35
Cost per Mile (Including Depreciation, Maintenance, and Direct Operating Cost)		.095
Gross Weight Capacity of Pickup, Lbs.....	4,800	
Weight of Pickup, Special Body, Equipment & Tools Lbs.....	4,100	
Additional Load Carrying Capacity, Lbs.....		700

On leases powered with multicylinder or horizontal single-cylinder gas engines, the pumper may also check, adjust, and service the engines and make all minor repairs.

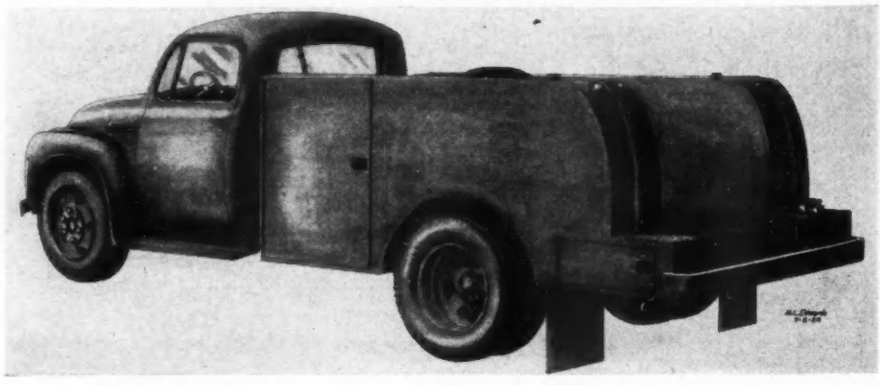
Reorganization and design of job. There is a broad range in the frequency with which pumpers visit their wells and facilities. It ranges from tour work and several visits each 24 hours to one visit every 48 hours, or even less. Obviously, the necessary frequency with which wells and facilities are visited is a major factor in determining the amount of operating labor required. Design of the well and lease equipment determines the necessary frequency of visits.

Methods studies reveal that the pumper often visits the wells more frequently than is necessary or than would be required to keep them producing if he had the proper tools and equipment to perform all the essential work on one visit. Repeat visits result in unnecessary time and mileage used in traveling about the job. In fact, approximately 25 to 50 percent of the usual pumper's total time is consumed in travel. Where the pumper walks his leases, the cost of his traveling one mile is approximately $1.50, whereas, the approximate cost for him to drive is 50 cents per mile. Personal car-allowance is sometimes the cheapest and best solution to this problem when pumper transportation is needed but the use of the pumper's personal car limits the amount and type of tools and equipment carried and the route driven on bad roads or in inclement weather.

A specially designed company pumper transportation unit not only provides all the necessary tools and supplies, but it can also be equipped with a portable air-compressor starting-unit which makes it possible to avoid the larger investment required for individual gas-engine starters at each well. For example, if a pumper handles 30 wells, the investment of $10,000 for individual gas-engine

FIGURE 3
Tune-Up and Service Mechanic Unit

Approximate Cost and Load Capacity:		
1 Ton Truck, Chassis & Cab, 152" Wheel Base—Dual Wheels.....	$2,128	
Special Body.....	1,577	
Tools and Equipment.....	1,385	
Total.....		$5,090
Estimated Approximate Average Miles per Day.....		50
Cost per Mile (Including Depreciation, Maintenance, and Direct Operating Costs)		.22
Gross Weight Capacity of Truck, Lbs.....	9,500	
Weight of Truck, Special Body, Tools & Equip. Lbs..	8,400	
Additional Load Carrying Capacity, Lbs.....		1,100



NEWLY-DESIGNED tune-up and service mechanic unit as seen from rear oblique.

starters can be replaced with an investment of $1000 for the portable starter and individual air-valves or air-starters on each engine.

Where a company's producing properties in a field consist of 50 wells within an area of 25 miles radius, or 100 wells within an area of 50 miles radius, methods studies reveal that in either case the better way to operate them is to assign a minimum number of pumpers, with specially equipped transportation units. Give them the sole responsibility of producing, measuring, and reporting the production volumes, putting in make-up oil and water, and of reporting equipment failures and doing minor clean-up. The preventive maintenance, oil changing, lubrication, adjustment and minor repair of equipment can then be done by one tune-up and service mechanic who is fully equipped to do this work.

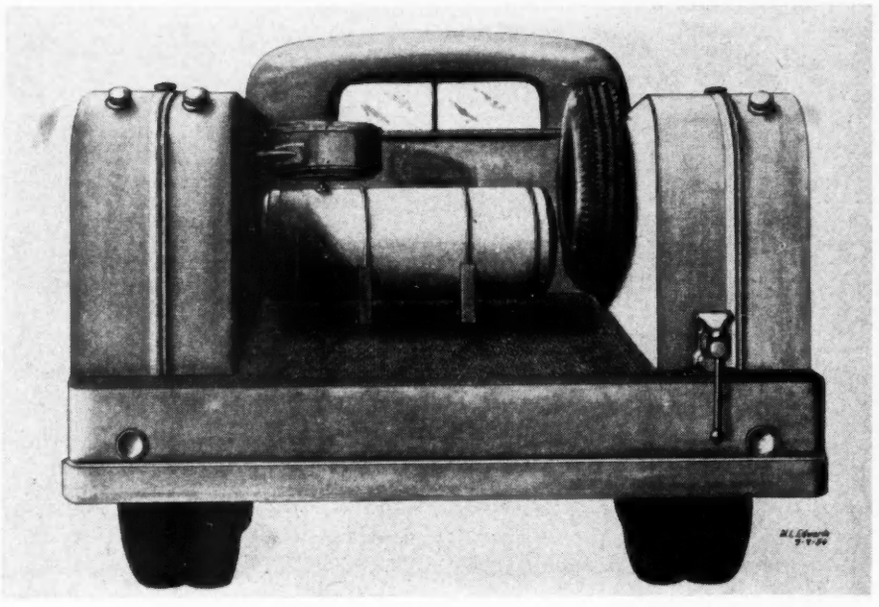


Fig. 4—Rear view of tune-up and service mechanic unit.

TABLE 1
List of More Important Pumper Tools

TOOLS
8", 10" & 12" Crescents
12", 18" & 24" pipe wrench
3 lb. Ball Peen Hammer
Shovel, rake, hoe, scraper
File
Broom
Pliers
Stuffing Box repacking tools
Screw driver
3 gallon bucket w/spout
Oil measure
Gage line
Thief
Centrifuge machine
Oil can (squirt)
Waste
Chemical can
PARTS
Spark Plugs
Magneto
Fan belts—Hose connections and clamps
Stuffing Box rubbers
Various packing
Pipe line leak clamps
Gasket material

Equipment for redesigned pumper's job. Table 1 is a list of the more important pumper tools and Figure 2 shows a specially designed water-tight tamper-proof pumper's transportation unit with air starting compressor and tank.

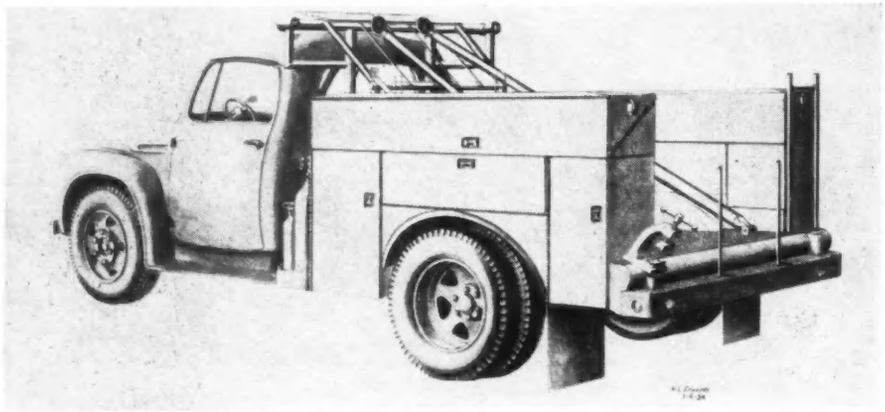
This unit weighs 4100 pounds and has an additional load carrying capacity of 700 pounds. The total cost of the unit is approximately $2545 and with an estimated travel of 35 miles per day, the necessary charge for the unit would be only 9.5 cents per mile.

Engine tune-up and service mechanic. Engine tune-up and servicing

TABLE 2
Detailed List of Operations Performed by Engine Tune-Up and Service Mechanic

Work Performed on Engines.
Check radiator temperature shutdown switch by drawing water from radiator.
Check radiator temperature and pH of water.
Check and service radiator with water or anti-freeze.
Check radiator hose, connections and fan belt.
Check R.P.M. of engine while pulling load.
Check and adjust fuel pressure.
Gauge manifold pressure.
Grease clutch.
Check motor mount bolts.
Drain oil from crank-case and check oil shutdown switch.
Drain, flush and replace oil-filter cartridge in filter case.
Clean and replace air-filter.
Remove and clean or replace spark plugs—check and set spark gap to specifications.
Check cylinder compression.
Check and adjust magneto or replace.
Remove valve inspection plate—check and adjust tappets.
Flush around valves and crank-case with solvent.
Replace valve inspection plate.
Check and time engine.
Replace spark plugs.
Fill crank-case with oil.
Check and replace wiring if needed.
Check and adjust clutch.
Check and adjust drive belt tension if needed.
Wash engine and base with solvent.
Check and remove fluid from both compartments of fuel-gas volume tank.
Start engine.
Apply carbon solvent to manifold.
Adjust carburetor using vacuum gage.
Recheck R.P.M. with engine loaded.
Clean radiator grill and screen when necessary.
Post "oil used" on engine operating card.
Check and service generator and battery on engines so equipped.
Work Performed on Pumping Units.
Lubricate all bearings with proper weight and amount of lubricant.
Check and maintain proper oil-level in gear-case.
Check all nuts and bolts on unit, adjust when necessary.
Drain, flush and refill gear-case when necessary.
Inspect and report worn parts on unit.
Check, replace or adjust drive belts when necessary.
Check unit shutdown switch if so equipped.
Check unit for proper balance, report if improper.
Check and report improper clearance of counterbalances from ground.
Prepare Equipment & Operating report for engine and pumping unit maintenance.

Fig. 5—Tune-up and service mechanic unit in background, with full compliment of tools and equipment laid out in foreground.



SURFACE MAINTENANCE roustabout unit which came out of the time and methods studies of many producing operations.

as performed by a specially-equipped and trained individual has not come into general use in the production of oil leases. Through the use of methods studies, this type of job has been designed and found to be superior to the usual practice of having the pumper perform this work in a haphazard manner. The major work performed by the tune-up and service mechanic is listed in Table 2.

Reorganization of work. Table 3 shows a comparison of engine and pumping-unit servicing time by the pumper versus the tune-up and service mechanic. The tune-up mechanic does the servicing work previously done by the pumper plus a complete equipment tune-up.

Through the adoption of the tune-up and service mechanic system on 46 wells with multicylinder and single-cylinder engines, one district effected a yearly savings in maintenance and labor of $250 per well, or a total of $11,500 with no added expense for mechanic's labor or transportation. This was accomplished because the resulting reduction in repair work permitted a reduction in the number of maintenance mechanics and transferring of the surplus maintenance mechanic over to the preventive maintenance work. In addition, the amount of downtime and lost production was decreased and the life of the equipment was increased.

Where a company has a greater concentration of wells, the savings will be greater than the foregoing because one properly equipped tune-up and service mechanic can service as many as 200 wells in a concentrated area.

FIGURE 6
Surface Maintenance Roustabout Unit

Approximate Cost and Load Capacity:		
1½ Ton Truck, Chassis & Cab, 152" Wheel Base, Dual Wheels, Winch	$2,107	
Special Body	973	
Tools & Equipment	520	
Winch (Installed)	483	
Total		$4,083
Estimated Approximate Average Miles per Day		35
Cost per Mile (Including Depreciation, Maintenance, and Direct Operating Costs)		.17
Gross Weight Capacity of Truck, Lbs.	14,000	
Weight of Truck, Special Body, Equipment & Tools, Lbs.	10,700	
Additional Load Carrying Capacity, Lbs.		3,300

Major tools and equipment needed. The more important tools and equipment needed for engine tune-up and servicing are listed in Table 4.

The tune-up and service transportation unit is shown in Figures 3, 4, and 5 with its water-tight, tamper-proof compartments and drawers. These provide for the systematic arrangement and storage of hand-tools, grease-guns, oil-cans, high-pressure air for starting and cleaning, oil and grease supplies for replenishing pumper stocks, repair parts, vice and many other details of convenience for doing the job.

This unit weighs 8400 pounds and has an additional load carrying capacity of 1100 pounds. Total cost of the unit is approximately $5090 and with an estimated travel of 50 miles per day, the necessary charge for the unit would be 22 cents per mile.

Surface maintenance. Surface maintenance operations include:

1. Repairs to pipe lines and systems.
2. Repairs to all types of lease facilities and equipment other than engines and pumping units.
3. Transfer or replacement of equipment.
4. Clean-up, weed extermination, and road grading.

The usual maintenance roustabout set-up includes verbal trouble reporting, verbal assignment of maintenance work and variation in the number of men in the crew. It also consists of inadequate or incomplete tools, equipment, and repair material to permit doing all types of jobs encountered in one day on a one trip basis. It is usu-

TABLE 3
Comparison of Time and Frequency Required by Pumper Versus Tune-Up Service Mechanic to Repair, Adjust, Lubricate, and Clean Engines and Pumping-Units

PUMPER

ITEM	Frequency Days	Time per Item	Total Time per Day/Well
1. Change Oil—Engine	30 Da. & (Various)	19.4 Min.	.65 Min.
2. Change Oil Filter	30 Da. & (Various)	5.4 Min.	.18 Min.
3. Grease Pumping Unit	30 Da. & (Various)	18.1 Min.	.60 Min.
4. Grease Engine	15 Da. & (Various)	1.2 Min.	.08 Min.
5. Repair to Engine	7 Da. & (Various)	91.7 Min.	13.10 Min.
6. Secure Oil & Parts	7 Da. & (Various)	5.6 Min.	.80 Min.
7. Extra Trips for Tools, Parts, Start Engine, Etc.	14 Da. & (Various)	42.0 Min.	3.00 Min.
Pumper's Average Total	.....	.....	18.41 Min.

An engine tune-up and service mechanic performs work that accomplishes the equivalent of the above work plus the additional work shown in Table II in the time shown below, including his travel time.

TUNE-UP MECHANIC

ITEM	Frequency Days	Time per Item	Total Time per Day/Well
1. Engine Tune-up & Service	30 Days	71.6 Min.	2.39 Min.
Net Savings	.....	.....	16.02 Min./Day per Well

ally necessary to return to the warehouse or store for additional tools or material.

The efficient maintenance roustabout set-up includes the optimum size of crew, properly equipped and supplied. Work is organized and assigned so that the various types of assigned field jobs can be successively completed during a full eight hours without interruption from lack of tools or material. This results in a minimum of travel time and maximum utilization of labor and equipment.

To accomplish this, the first step is to establish a written communication (job order) system that will show the exact location, nature of job, and parts and material needed. This permits the supervisor to determine the priority of each job, equipment, tools, and material needed on each job, type of crew and most efficient crew size to use, and to plan the entire day's work for each unit. The same job-orders then serve the crew for a written schedule and for reference on each of the assigned jobs.

Methods studies show that 90 percent of lease maintenance work can be efficiently performed by a properly equipped two-man crew. The other 10 percent of the work requires more than two men for short periods of time to lift, move, or hold heavy equipment. Jobs in this latter category can be handled by a company which has two or more small crews in a field by combining the two small crews temporarily for the few jobs requiring more than two men.

In one case, four five-man crews with inadequate planning, tools, and equipment were replaced with four properly equipped two-man crews operating on a planned schedule. The four two-man crews were able to take care of the current work in a better manner and to reduce the back-log of work by one-third. The total yearly labor and mileage savings was $70,000.

Major tools and equipment. Some important features of the tools and equipment used include:

1. Power winch and telescoping shear poles to lift, hold or position heavy equipment.
2. Oxygen and acetylene cutting equipment that essentially eliminates use of hack-saws, cold-cuts, and chisels.
3. Complete power threading equipment.
4. Fire-fighting equipment.
5. A special tool bed with water-tight and tamper-proof drawers and compartments for all regular tools, equipment, and supplies and enough space and carrying capacity for special supplies or machinery for the day's work.

Table 5 shows a complete list of small tools, equipment and supplies for lease maintenance work. Figure 6 shows a view of the planned and designed lease surface maintenance roustabout unit. This unit weighs 10,700 pounds and has an additional load carrying capacity of 3300 pounds. Total cost of the unit is approximately $4083. With an estimated travel of 35 miles per day, the neces-

TABLE 4

List of More Important Tools and Equipment for the Engine Tune-Up and Service Mechanic Work

ITEM	Quantity
TOOLS	
Thermometer 0 to 300°	1
Drain bucket—5 gallon w/lip	1
Heavy canvas w/hang bar	1
Radiator hose cutter	1
Scrapping Tool (Snap-on No. CS1)	1
Wire Brush & 4" Paint Brush	1 ea.
Pry bar (Snap-on No. 1650)	1
Hydrometer (No. 8 Eldelmann)	1
Tachometer w/adaptors	1
Pressure gages w/⅛" to ¼" adaptors	2
1 quart Oil pour, & oil squirt can	1 ea.
Vacuum & fuel pump gage (Snap-on No. MT-14)	1
Compression gage (Snap-on No. MT-24)	1
Timing light (Snap-on No. TL-89)	1
Flashlight w/long flexible head—3 cell	1
Flywheel marking chalk	2 sticks
Hand grease-gun w/alemite & zerk adaptors	1
Grease-gun filling devices	1
Air-hose	40'
Retractable air-hose reel	1
Starter w/copper plate on terminal	1 ea. type
Battery cables (25' long)	1 set
12 volt ignition system w/battery	1
Battery water filling container	1
Vise (Superior No. 44)	1
Wash pan (12" x 4" deep)	1
Air compressor w/kit (Westinghouse Type F-12)	1
Air tank (24" x 46")	1
Air spray-gun (Alemite No. 5328)	1
Hand suction gun	1
Drain trough (Home made)	1
Oil measuring can w/flexible spout	1
Feeler gage (Snap-on No. 324)	1
Equipment & operating report form	1 book
Oil transfer pump	1
Water cooler	1
Shovel	1
Fire extinguisher	1
SUPPLIES:	
Stop-leak fluid	2 cans
Sealing compound (Form A Gasket)	1 can
Treated water	50 gal.
Water-pump grease	1 lb. can
Pumping-unit lubricant	5 gal. oil 25 lb. grease
Battery terminal cleaning agent	2 lb. box
P I B w/applicator (water proofing liquid)	2 bottles
Battery water	5 gal.
Cleaning solvent	20 gal.
Rags	10 lbs.
Engine oil—SAE 20 or 30	50 gal.
Top-cylinder lubricant	5 gal.
REPLACEMENT PARTS:	
Temperature shut-down switch	1 ea. type in use
Fan belts	1 ea. set
Radiator hose and clamps	1 set ea. size
5 gallon supply can	2
Extra gage cocks	4 ea. ⅛ & ¼" both male & female
Cast iron plugs	6 ea. ⅛, ¼, ⅜, ½, ¾, & 1"
Zerk & Alemite fittings	6 ea. ⅛ & ¼"
Grease line flexible connections	2 sets each size
Battery cables	2 ea.
Generator brushes	1 set ea. type
Magneto drive couplings	1 ea. type
Magneto points	1 set ea. type
Magnetos	1 ea. size & make
Inspection plate gaskets	1 ea. size
Filter elements w/gaskets	Nc. to be determined
Oil line tubing ⅛" and ¼"	10' ea. size
Ferrule & adaptors for ⅛" & ¼" tubing	6 ea.
Filter assembly complete	1 ea. type & size
Spark plugs	1 set ea. size & type
Spark plug wire	1 spool
Spark plug wire connections	12 ea. size & type
Magneto Base Bolts	1 set ea. size
Contact clips for Magneto wire	12 ea. type & size
Oil Pressure switch	1 ea. type

TABLE 5

List of More Important Tools and Equipment for Lease Maintenance Work

ITEMS	Quantity	Size
Pipe Wrenches	2 ea.	24" & 36"
Pipe Wrench	1	48"
Pipe Hooks	3	2"
Pipe Dies	1 set	1" to 2"
Pipe Line Jack	1	.....
Pipe Cutters	1 set	2" to 4"
Picks	2	.....
Axe	1	.....
Sledge	1 ea.	10 & 16 lb.
Belt Stretchers	1	Set
Rod Line Jack	1	Set
Pry, Nail, & Pinch Bar	1 ea.	3, 5 & 6'
Dip Bucket w/handle	1	.....
Rubber Mat	1	4' x 4'
Crescents	2 ea.	8, 10, 12, 15 & 24"
Pipe Wrenches	1 ea.	10" & 18"
Hack Saw	1	No. 2
Hammer "Ball Peen"	1 ea.	No. 2 & No. 3
Belt Punch, Chalk 1 Stk	1	9"
Box of Tools for Belt Job	.....	.....
Belt Punch	1	11/16"
Screw Drivers	2	6" & 10"
Pliers	1	10"
Punch	1 ea.	¼" & 5/16"
Chisels	1 ea.	½" & 1"
Round File	1	14"
Mill Bastard File	1	14"
3 Corner File	1	.....
Allen Wrenches	1 set	.....
Goggles Clear	2 sets	
Pipe Dies	1 set	⅛" to 1"
Claw Hammer	1	.....
Hatchet	1	.....
Chalk	1	Stick
Drill Bar	1 ea.	¾" & 1¼"
Wire Brush	1	.....
Level	1	.....
Brace & Bits	1	⅛" to 2"
Chalk Line	1	100'
Goggles, Welding	1 set	.....
Dresser Wrench	1	.....
Sockets w/Ratchet	1 set	½" Drive
Sockets Heavy Duty w/Ratchet	1 set	¾" Drive
Tape Measure	1	100'
Lazy Board	1	.....
Rags	1 box	
	10 lbs.	.....
Thread Compound	1	Can
Oil Can	1 ea.	
	1 qt.	1 gal.
Gasoline	1	1 gal.
Kerosene	1	1 gal.
Trombone Water Spray	.....	.....
Pressure and Vacuum Gage	1	30—60#
Pressure Gage	1	350#
Connections	.....	.....
Line Clamps	4 ea.	2, 2½, 3 & 4"
Wire Line Clamps	4 ea.	¾" & 7/8"
Packing	1 lb.	¼"
Packing	1 lb.	¾"
Gasket Material	2 lbs.	⅛"
Nails	2 lbs. ea.	No. 8, 16, 40
Stuffing Box Rubbers	3 lbs. ea.	1⅛"—1⅜"
Belt Clamps	3	10, 12 & 14"
Lunch Boxes & Spare Clothes	.....	.....
Tire Jack	.....	.....
Round Point Shovels	3	No. 2
Spades	2	.....
Cross Cut Saw	1	.....
Hand Saw	1	.....
Square	1	18" x 24"
Winch, Line & Telescope Poles	.....	.....
Rope	25'	¾"
Chains 1—⅜" x 20' Chain	2	¼" x 18'
Load Binders	1	⅜"
Pipe Vise	1	.....
Oxygen Bottle	1	.....
Acetylene Bottle	1	.....
Acetylene Cutting Equipment	1	Set
Polished Rod Clamp	1 ea.	1⅛" & 1¼"
Water Can "Drinking Water"	1	5 gal.
Water Can "Fighting Fire"	2	5 gal.
Drinking Cups w/dispenser used Cup Container	2 Boxes	.....
Du-Gas Fire Extinguisher	1	Model No. 30
Tire Chains	.....	.....
Bolt Dies	.....	¼ to 1"
Miscl. Bolts, Washers & Nuts	.....	.....

Fig. 7—Full compliment of tools and equipment which go into the compactly designed surface maintenance roustabout unit.

sary charge for the unit would be 17 cents per mile.

Figure 7 shows another view of the surface maintenance roustabout unit with all the tools and special equipment laid out. The rotary pump mounted on the front of the truck is used to pump water out of the bell hole when a leak clamp must be placed on a line under pressure.

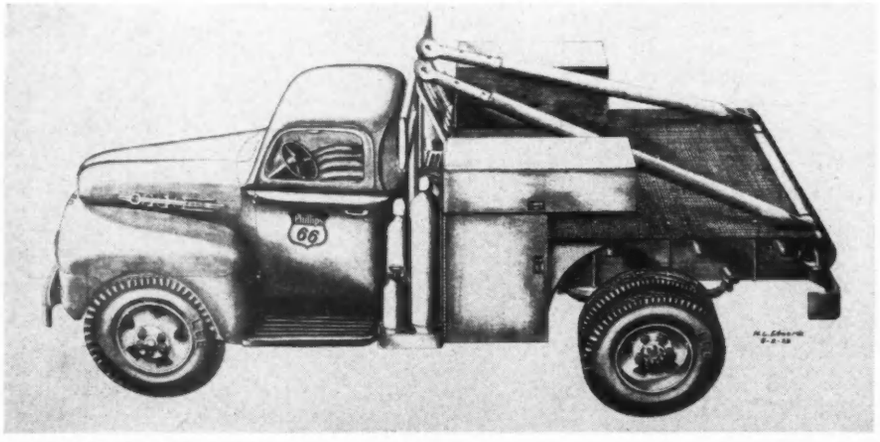
FIGURE 8
Heavy Field Mechanic Unit
(For repair of engines, pumps, and units)

Approximate Cost and Load Capacity:		
1½ Ton Truck, Chassis & Cab, 152" Wheel Base, Dual Wheels, Winch	$2,107	
Special Body	528	
Tools & Equipment	240	
Winch (Installed)	470	
Total		$3,345
Estimated Approximate Average Miles per Day		50
Cost per Mile (Including Depreciation, Maintenance, and Direct Operating Costs)		.15
Gross Weight Capacity of Truck, Lbs.	14,000	
Weight of Truck, Special Body, Tools & Equipment, Lbs.	7,900	
Additional Load Carrying Capacity, Lbs.		6,100

Machinery maintenance mechanic. The machinery maintenance mechanic work associated with the field repair of engines, pumps, and pumping units can be planned, scheduled, and handled with properly equipped small crews in much the same manner as that described here for general lease surface maintenance work. This work includes field repairs to engines, pumping-units, pumps, and gear boxes, as well as other heavy machinery, and the change-out and transfer of this type of equipment.

The specially designed unit for this work not only provides all tools necessary for all types of field mechanic repair jobs but also provides a means for handling and transporting the heavy units of equipment. The ability to move and change out heavy units of machinery eliminates the extra expense, lost motion, and wait-

Continued on Page 156



SPECIALLY DESIGNED heavy field mechanic unit used in the repair of engines, pumps and pumping units. It is capable of lifting, pulling and carrying heavy loads.

About the Authors

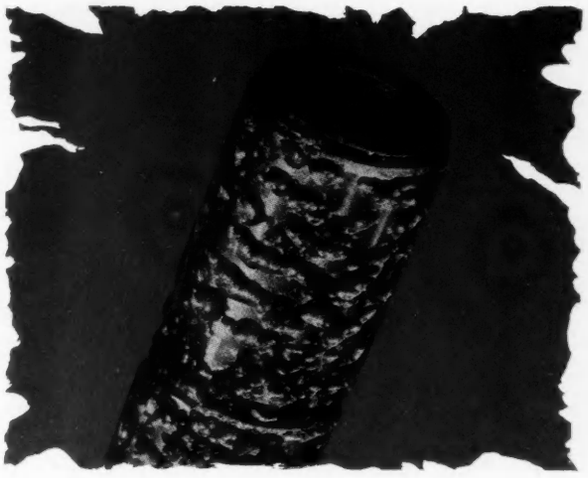
HAROLD S. KELLY has been chief engineer of the Production Department of Phillips Petroleum Company in Bartlesville, Oklahoma, for the past ten years. He has been active in production operations and petroleum engineering for the past 24 years. His fourteen years of field experience cover the Mid-Continent and California. He has been active in the Petroleum Branch of AIME and the American Petroleum Institute for several years.

•

ROGERS C. FILSON, coordinator for methods analysis, Production Department, Phillips Petroleum Company, Bartlesville, Oklahoma, has a background of more than 25 years of production experience. Since 1945, he has been actively engaged in directing methods analysis programs in principal oil producing areas of the U. S. For the past seven years he has been a conference leader of the yearly Job Design Conference held by Oklahoma A & M College, and has served on various panels and seminars of other colleges and oil companies in the Mid-Continent area.

This is trouble...

This unretouched photo shows a plunger section taken from a pump operating in a Mid-Continent oil field. The extreme pitting indicates what corrosive and abrasive action can do to a pump part when it is not metallurgically suited to the well condition. A wrong specification of parts for the specific well condition might be the cause of failure.



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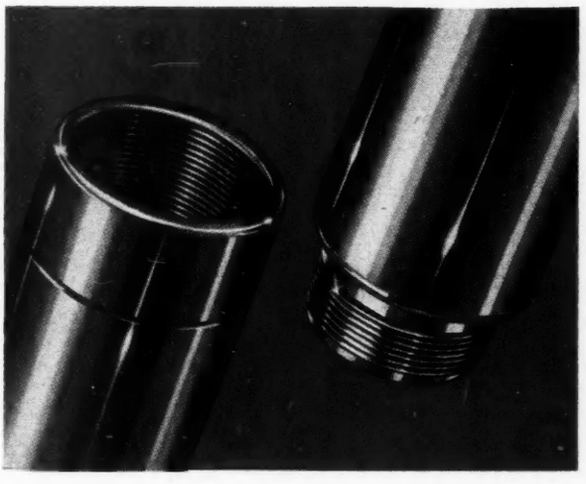
Here's why ... Axelson has available, not one, but *many* different plungers, each designed for a *specific* well condition. Axelson is the only pump manufacturer operating *its own foundry,* thus establishing complete quality control for alloy castings. Super rigid physical and chemical specifications guarantee quality of carbon alloy and stainless steel tubing. These are some of many reasons why Axelson plungers have: (a) the proper strength to absorb shock loading and so minimize fatigue; (b) high resistance to corrosion; (c) maximum hardening to resist abrasion.



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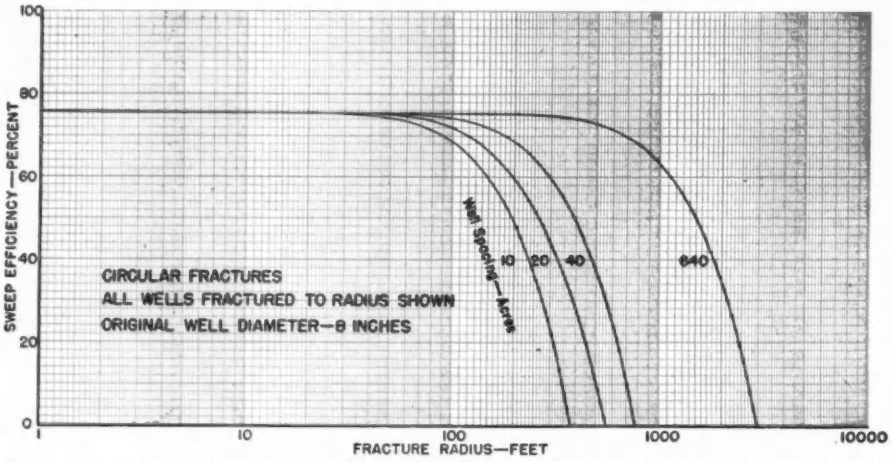

Fig. 1—Sweep efficiencies of the staggered line-drive (square) pattern in horizontally fractured thin reservoirs.

Water-flooding and gas cycling affected by . . .

Horizontal Fractures In Thin Reservoirs

Part 6: Sweep efficiency of staggered line-drive pattern.

By DR. PAUL B. CRAWFORD, Texas Petroleum Research Committee, Texas A & M, College Station, Texas

THE UNFRACTURED staggered line drive pattern has been indicated to have a high sweep efficiency. Since reservoir fracturing techniques are now being employed, it appears appropriate that studies be made to estimate the effect of fracturing on the sweep efficiency. Results presented here assume that circular or "pancake" fractures of the same radii exist at all wells in an infinite array of staggered line drive patterns. This idealized system was considered to show how the sweep efficiency varied as the radius of the fracture increased in 10, 20, 40 and 640-acre well spacings.

The problem. In analyzing this problem, potentiometric model studies were made in which a thin copper disc simulated the horizontal fracture. These copper discs were of various radii in different experiments and were located at the top or bottom of the reservoir in the studies. In this work it was found that the existence of the fracture in thin reservoirs would not disturb normally existing isopotentials from the periphery of the fracture to the opposite well or fracture. This was approximately true, regardless of whether the fracture was located on the top or bottom of the reservoir. It was realized that such can only be the case for a thin reservoir.

Studies conducted were such that the ratio of the thickness of the reservoir to the well spacing was equal to 0.022. This corresponds to 15 feet of pay in a ten-acre well spacing or 115 feet of pay for a 640-acre spacing. The data may also apply for thicker sands, but this is not known at this time. It is known, of course, that if impermeable strata are correlated from well to well and that such strata occur at approximately 15 feet intervals, the data presented herein may be used to estimate the sweep efficiency of water flooding or gas cycling the reservoir.

Muskat and Wyckoff[1] presented a mathematical analysis of the staggered line drive pattern for the unfractured system. The work done in this laboratory showed how their work may be used for circular horizontally fractured patterns. It was found that the sweep efficiencies for the case of circular horizontal fractures would be equal to that of the unfractured pattern minus the percentage area occupied by the fractures. This relation holds true as long as the radii of the fractures do not exceed the substantially circular isopotentials normally existing around each well in the unfractured staggered line drive pattern. The approximately circular isopotentials for the 660-foot well spacing do not exceed approximately 100 to 150 feet from each well. Other data on unfractured systems for fractures of greater radii could be used provided it was known that the shape of the fracture conformed to the approximately elliptical isopotentials which exist for the unfractured case.

Staggered line drive efficiency. Figure 1 shows the staggered line drive sweep efficiency for the case of circular horizontal fractures existing at all wells. The pattern is considered to be square. That is, the distance between the lines of input and output wells is equal to the distance between adjacent input or output wells. Sweep efficiencies have been calculated for the case of steady state conditions at a mobility ratio of one.

For thin reservoirs, it was found that the sweep efficiency without fracturing was expected to be near 76 percent of the area of the square. For the ten-acre spacing it will be noted that the creation of fractures of 30-foot radius at all wells will result in a sweep efficiency of approximately 75 percent. Fractures of 50-foot radius will result in sweep efficiencies near 74 percent, and fractures near 150-foot radius are expected to result in sweep efficiencies near 60 percent. For the ten-acre spacing it will be noted that if the fractures exceed 150 feet, the sweep

PRODUCTION PROBLEM SOLVED IN UINTAH COUNTY NEAR VERNAL, UTAH

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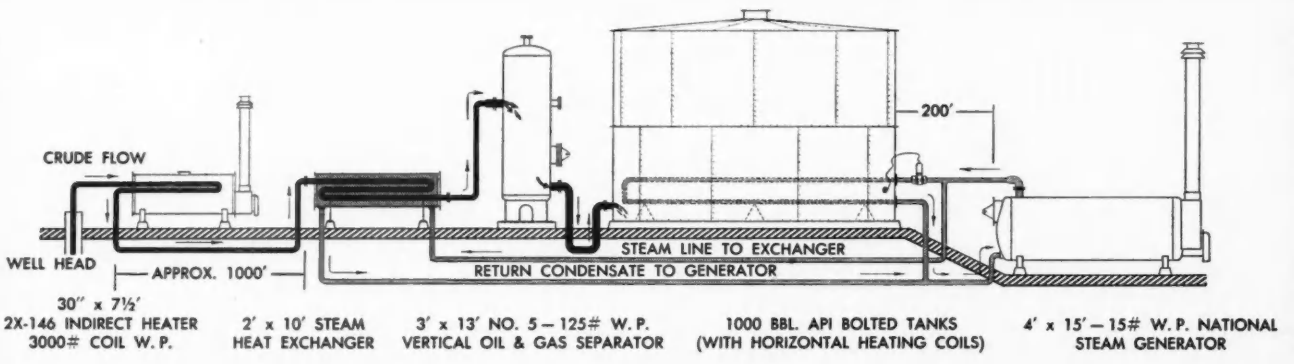

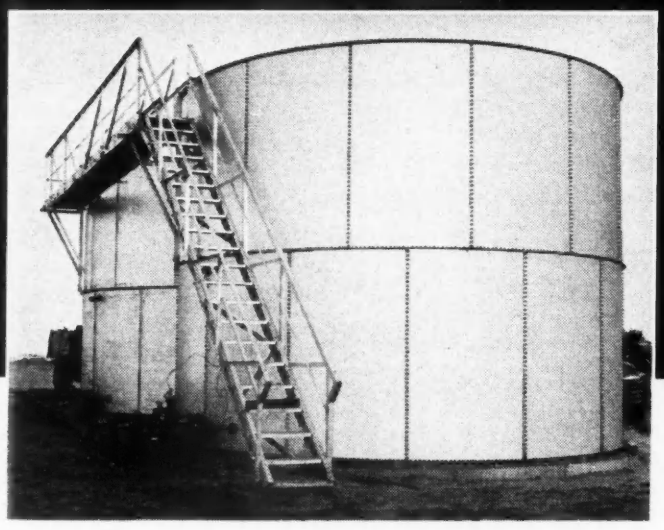

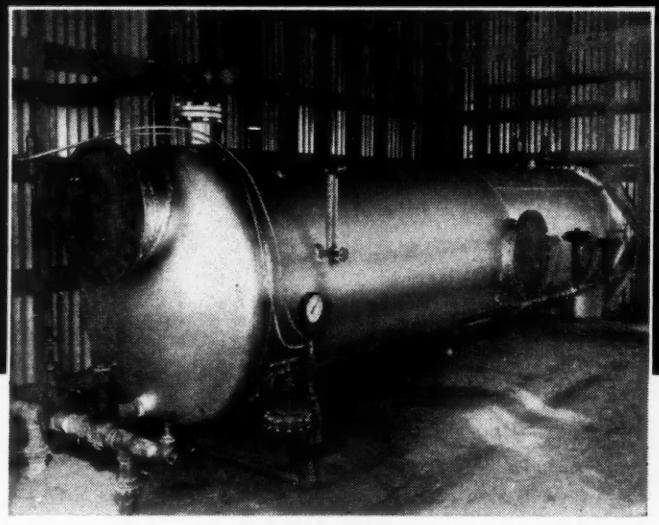

Solution — National Tank Company equipment is set as per the above flow diagram. An indirect heater is set at each well head for a flow line heater in order to keep production at a high enough temperature to prevent congealing in the lines. Before separation, the production is subjected to an additional heat through a Steam Heat Exchanger so that gas can properly be separated from the oil in the oil and gas separator. Each tank is thermostatically controlled at a temperature of 110° preparatory to being shipped by truck as there is no pipeline connection available at present time. A 4' x 15' two million BTU 15# W. P. National Steam Generator is installed along with coils in each tank to keep the production to 110-degrees in the stock tanks. This is a closed system with the generator set at a lower level than the tank grades and the condensate line buried from the tanks back to the unit. Atmospheric temperatures in this area range sometimes as low as 40° below zero in the winter months.

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efficiency declines very rapidly as the radius of the fracture increases, approaching zero as the fracture radius approaches 370 feet.

For a 20-acre spacing, fractures of 85-foot radius will result in sweep efficiencies near 73 percent. Fractures of 180-foot radius will result in sweep efficiencies near 64 percent. Fractures of greater radius result in a sharp decrease in the sweep efficiency. For the 40-acre well spacing, fractures of 120 feet will result in sweep efficiencies near 73 percent. Fractures of 260 feet will result in sweep efficiencies near 64 percent. Fractures greater than this indicate a very rapid decline in the sweep efficiency. For the 640-acre spacing, it is shown that fractures of 470-foot radius are expected to result in sweep efficiencies near 73 percent. Fractures in 980 feet are expected to result in sweep efficiencies near 64 percent.

If the sweep efficiency is to be maintained at a high level and the element of risk minimized, it is suggested that the fracture radii for the ten-acre spacing be within the range of 30 to 50 feet. Fractures in that particular range will result in increases of conductivity by a factor near four. This implies that if the normal flood-out time requires 30 months with no fractures that it may only require 8 months after fracturing. Corresponding ranges of fracture radii for the 20, 40 and 640-acre spacings are approximately 40 to 80 feet, 80 to 120 feet and 250 to 470 feet, respectively. Such fractures are expected to result in sweep efficiencies within three percent of those which would occur if no fractures had been present. In addition, since flooding and cycling operations are conducted after the injected fluid has appeared at the production well, other work has shown that the swept area for the given fractures cited above will be approximately that which would have occurred had no fractures existed.

It is conceivable that a sweep efficiency at breakthrough near 76 percent could be obtained if the fracturing of the input wells were postponed for a short time after fluid injection had started. If the quantity of water or gas injected is such that the interface of the invading and displaced fluids is beyond the radii of the postponed fractures, then the quantity of oil or distillate normally remaining above or below the horizontal fracture would be displaced to the opposite well. This could result in an increase in oil recovery of approximately one to three percent for fractures of the range stated above. Consequently, it may be advantageous to postpone the fracturing of input wells in fluid injection processes for a short period of time after initiation of the program.

Conclusion. Studies have been made of the sweep efficiencies of the horizontally fractured staggered line drive pattern. The fractures were considered to be circular and to originate at the well. For the case of 10, 20, 40 and 640-acre spacings, radii of the fractures should perhaps not exceed 150, 180, 260 and 980 feet, respectively. To do so may result in a substantial decrease in the sweep efficiency and possibly poor performance after breakthrough of the injected fluid. It is also indicated that desirable fracture radii for the above four well spacings may be near 30 to 50 feet, 40 to 85 feet, 80 to 120 feet and 250 to 470 feet, respectively. Fractures in the above range are indicated to increase the conductivity of the pattern by factors of three to four, and also carry less element of risk in obtaining fracture interconnections.

Sweep efficiencies will be approximately one to three percent of those which would be obtained if no fractures occurred. Other work has indicated that the performance after breakthrough for fractures in the desirable range will be substantially the same as for the case of no fractures. It is suggested that prior to the injection of fluid into a horizontally fractured well that studies be made to estimate the radius of the fractures to insure that they fall wihin the desired range. If the fracturing process can be controlled with certainty, more precise recommendations may be formulated for the different well spacings and patterns.

REFERENCE

[1] Muskat, M., and Wyckoff, R. D., "A Theoretical Analysis of Water Flooding Networks," AIME Trans., Vol. 107, P. 62 (1934).

To Be Continued

Job Analyses

Continued from Page 152

ing time incurred with the use of a separate winch truck.

Major components of this unit include:

1. Complete lay-out of mechanics tools and parts.
2. Power winch and telescoping shear poles.
3. Oxygen and acetylene cutting equipment.
4. Fire-fighting equipment.
5. A special body with water-tight, tamper-proof drawers and compartments and flat bed space for carrying machinery.

Fig. 8 shows a view of the specially designed machinery maintenance mechanic unit.

In addition, special units similar to the ones shown have been designed for field-testers, electricians, and well-service auxiliary transportation.

A new way. The most effective procedure for improving lease operations and maintenance incorporates four distinct phases which are:

1. Making detailed methods studies of the current operations and determining the minimum necessary activities.
2. Redesigning, integrating, and organizing the jobs for greater efficiency. Installation of different or improved lease equipment may be justified in some cases on the basis of the savings to be realized.
3. Providing the necessary tools, equipment and facilities and the properly sized and trained crew for effective and efficient execution of the redesigned jobs.
4. Following-up with checks and methods studies to make certain the operations and maintenance are being carried out as planned.

Maximum improvement of lease operations and maintenance cannot be achieved if any one of these four steps is omitted.

ACKNOWLEDGMENT

This paper originally presented at the fall meeting of the Petroleum Branch, AIME, in San Antonio, Texas, October 17-20, 1954, under the title "Producing Lease Operations—Design of Operating and Maintenance Jobs and Related Tools and Transportation Equipment."

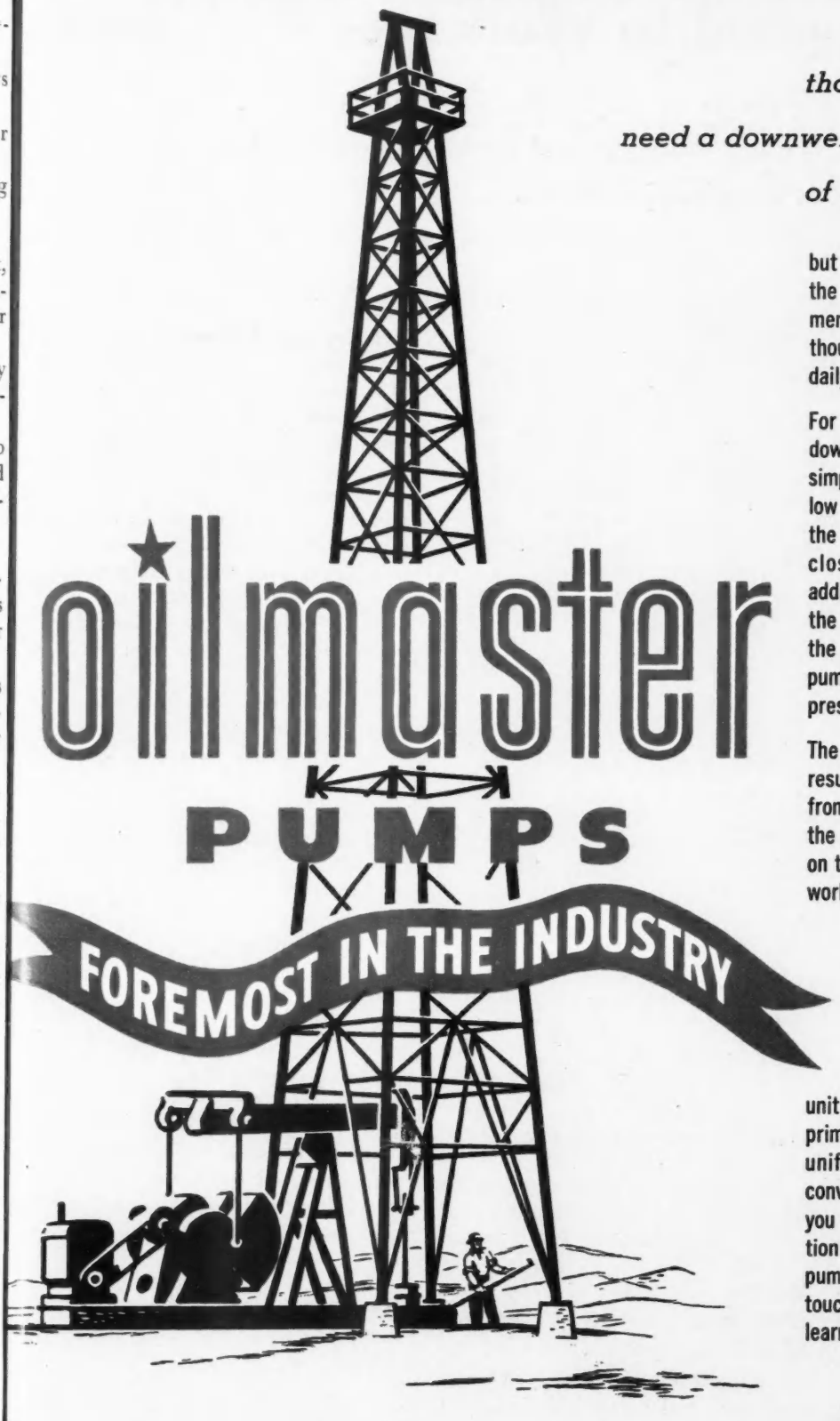
REFERENCES

[1] R. C. Filson and J. E. Daxon: "Applying New Techniques Through Job Design." Delivered at the Spring Meeting of the Rocky Mountain District, A.P.I. Division of Production, Casper Wyoming (April 13-14, 1950).

[2] R. C. Filson: "How to Reduce Lease Operating Expenses." *World Oil* (February 1, 1953), 136, (2), 60.

—The End

WE HAVE HESITATED TO SUGGEST...



that an oil well might need a downwell compressor instead of a downwell pump...

but we have become increasingly aware of the limitations of a single acting displacement pump for wells that must produce many thousand cubic feet of gas along with the daily production of oil. Solution...

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The combination achieved some interesting results. With the top of the plunger protected from the high pressure fluid in the tubing, the pump couldn't pound fluid. The fluid load on the hollow polished rod did the necessary work of compressing the gas and transferring the fluid from the pump barrel to the annular chamber on the downstroke, and in addition it kept the rods in tension.

We could go on — lower load range on the rods meaning lower torque on the unit gear box and less horsepower from the prime mover. No more gas lock meaning more uniform production, less destructive heat converted in the pump. But we suggest if you are interested in more efficient operation than you can obtain from a conventional pump in gassy or foamy wells that you get in touch with your Oilmaster representative and learn all about the

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Horizontal Drainhole Techniques Applied to Workover Problems

Increased drainage area has brought new life to marginal producers.

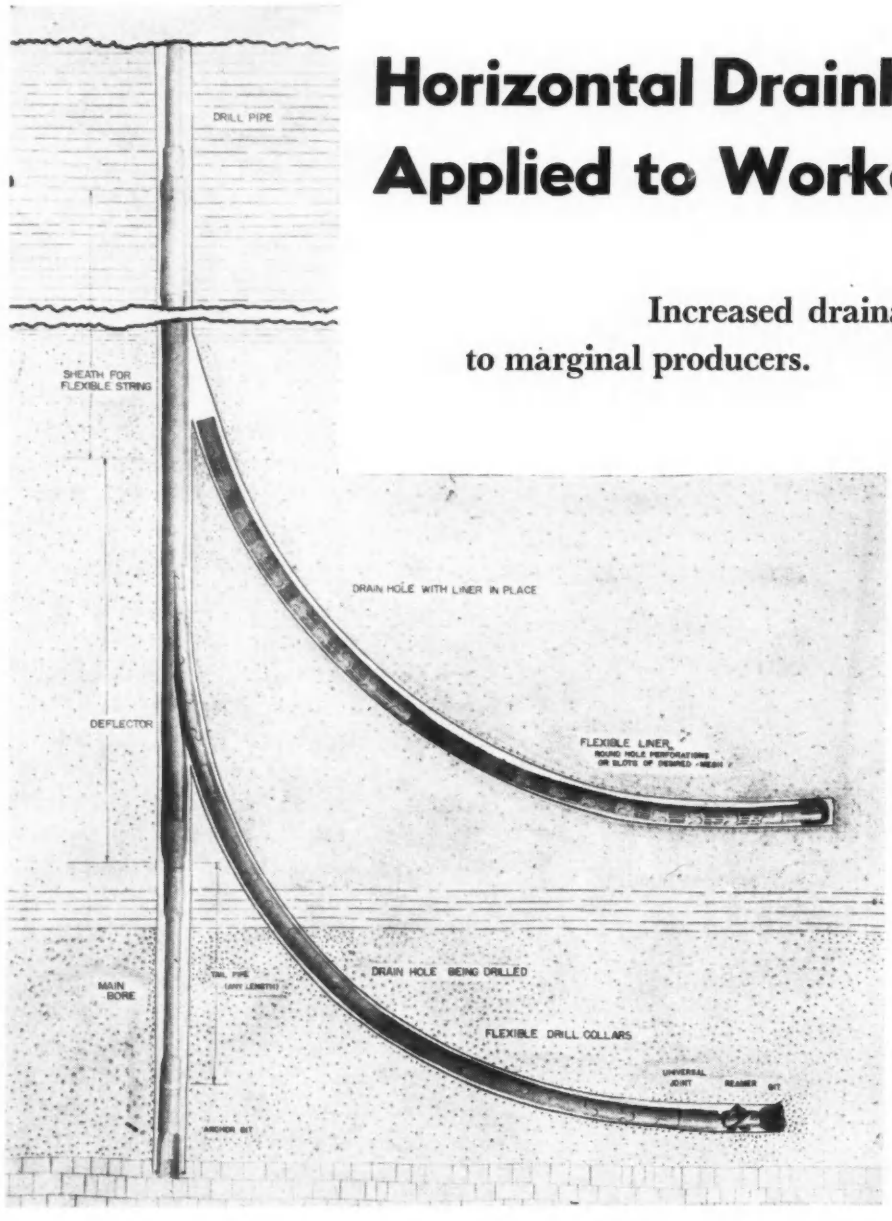

Fig. 1—Technique of drilling and completing horizontal drainholes illustrated in this drawing. Flexible slotted or perforated liner set in curved hole after being drilled by bit with flexible drill collars.

By CARL O. SPATH, The William E. Sievers Corporation, Long Beach, Calif.

A RECENT DEVELOPMENT in oil well workovers is the application of horizontal drainhole techniques. General purpose of this work is to satisfy redrilling requirements without drilling a totally new well or even the expensive direction out-of-casing redrilled hole. The necessity of recovering additional drainage from already semi-depleted productive formations stimulated the idea of employing drainhole techniques to place a production liner in an equivalent zone, yet as far away from the old contaminated area as possible.

By pulling the liner where possible, by milling a section opposite the damaged production interval or by milling a window off of a permanent or removable whipstock, drainholes may be deflected to penetrate in fresh areas of the local petroleum reservoir. Sand and shale bodies, previously known to have potential value, but already cemented behind casing, can now be penetrated and tested for production using perforated liners as shown in Figure 2 and eliminating the expense of drilling new wells.

Description of tools. Operation of drainhole drilling tools utilizes the basic principles of a whipstock for initial deflection, along with a combination bit and reamer (fulcrum) to continue building the angle of drift. The flexible drill collars incorporate a four-lobe cut which assures universal action and positive deflection off the whipstock. Drill collars are made sufficiently flexible to follow the rapid angular change of the drainhole as it is drilled off of the high angle (14 degree) whipstock face and the additional hole that is building drift angle at the rate of 3 to 5 degrees per foot of penetration.

The whipstock is positioned below sufficient sheath pipe to completely enclose the flexible drilling assembly (Figure 2). This permits the drill bit and assembly to rotate in the drainhole, while the sheath pipe and whipstock remain stationary in the main bore. Any appropriate sized rock or diamond bit may be used along with the universal joint and a reamer sub which supports the bit while drilling ahead. Size of casing set in the main bore determines the size of drainhole that may be drilled, since the casing diameter confines any whipstock and bit that may be run through the casing. Relationship between casing size, drill collar and drainhole size are shown in Table 1.

How equipment works. The tools are made up at the rotary table and

TABLE 1

Casing Size	Whipstock	Flexible Drill Collar	Range in Size of Drainhole
5½"	4½"	3¼"	3¾" to 3⅞"
6⅝" & 7"	5½"	4¼"	4¾" to 4⅞"
8⅝" to 12¼"	7"	4¼"	6¼"

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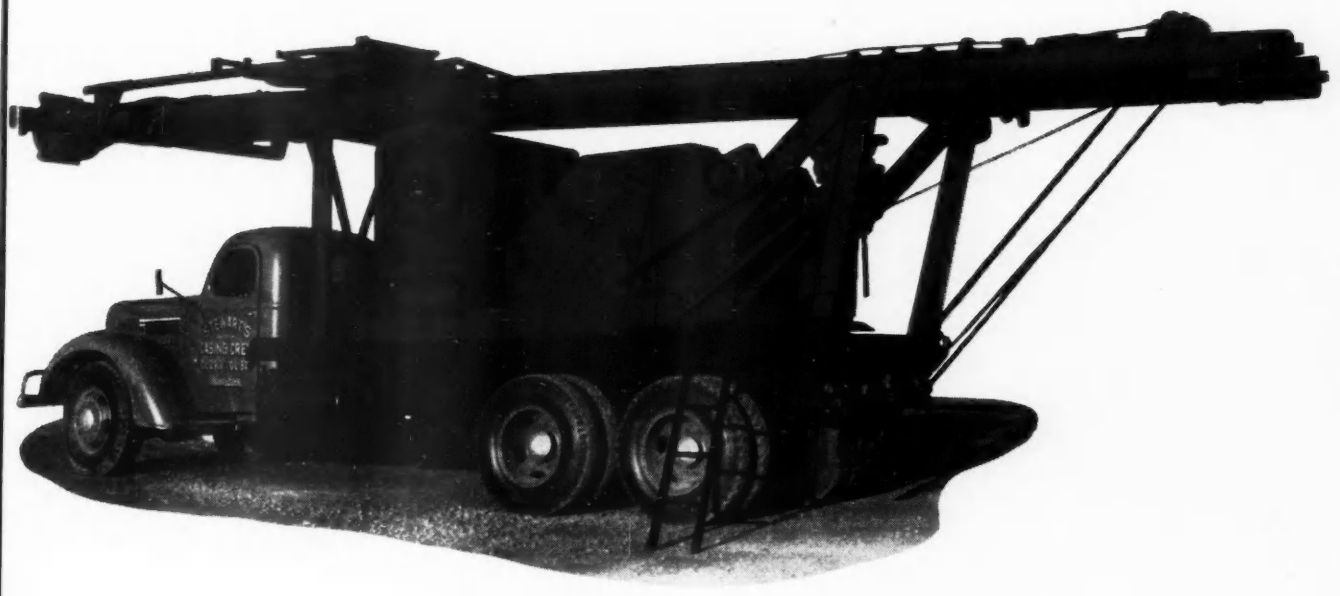

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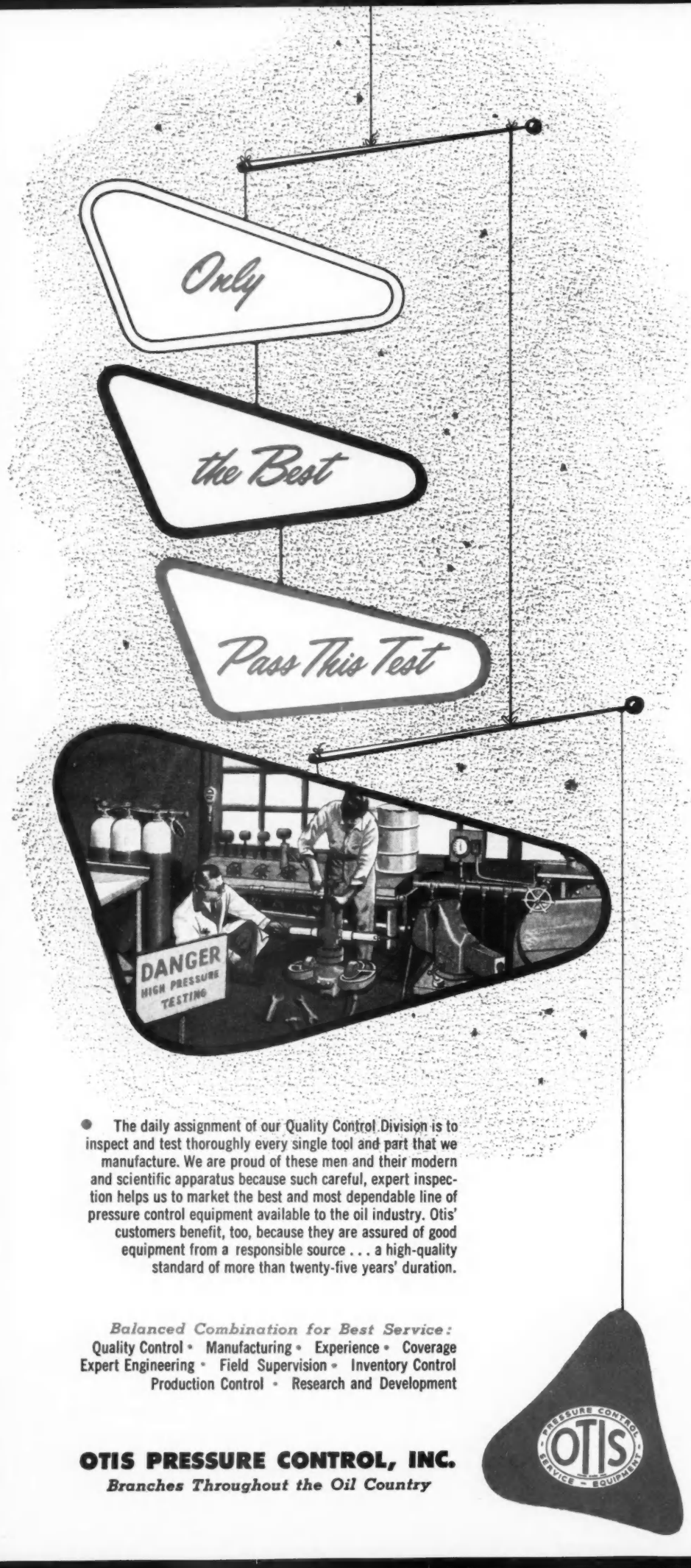

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run in the hole in much the same manner as any conventional removable whipstock. The take off point of the whipstock face determines the window of the drainhole. This depth may be determined by running a leg and anchor beneath the whipstock and standing the whipstock off bottom. As many as three drainholes may be drilled at a single level using this assembly.

After the whipstock and flexible drilling assembly have been set at the desired position, a pin is sheared by slacking weight on the string until the pin breaks. The pin is sheared by the weight of the drill pipe and not by the flexible drill collars. After each drainhole has been drilled, the flexible drilling string is pulled into the whipstock sheath until the centralizer sub wings expand through the opening or windows in the top of the sheath pipe assembly. The whipstock may then be turned and repositioned. Another drainhole may then be drilled.

The whipstock is fabricated with a face angle of 14 degrees. This causes the drilling bit to leave the face of the whipstock with positive sidetracking action and at this time the universal joint will force this assembly to increase the drift at a rate of approximately 3 to 5 degrees per foot of hole drilled. Drainholes have been surveyed by qualified service companies and the results, to date, reveal that the drainholes can achieve a horizontal position in approximately 20 feet of drilled distance and this lateral distance requires but 12 feet of vertical depth. It is now practical to remove the universal joint after drilling with the complete flexible assembly to any given drift angle and then continue to drill ahead, maintaining the desired drift angle.

After each drainhole or as many drainholes as are desirable have been drilled, flexible liners of any desired mesh and rows may be run in the drainholes to act as protection against caving. The liner is simple in construction and is generally manufactured from heavy wall tube stock or used drill pipe, depending on the availability of material and the size liner desired. Standard perforations are used, depending on the requirements of the operator. The pipe is perforated before it is made flexible, hence it is only necessary to perforate the desired mesh, number of rows,

length of slots or diameter of holes. The perforating company will leave the necessary mills or drills out of the perforating machine and the blank space is then utilized for the flexible cut. The flexible cut can be made in any reasonable desired width or spacing, depending on the sand condition of the well in which the liner will be set. The amount of opening in the flexible cut can be made to have approximately the same area as each foot of perforation.

A well in Ventura County, California, had been producing 5 barrels of oil per day for several years after declining from an initial rate of 29 barrels per day. A bridging plug was set in the perforated liner to eliminate bottom water, and to act as a foundation for the whipstock. Drain-hole tools were used to mill a casing window in the 7-inch, 20-pound H-40 casing, drill 100 feet of hole at an average drift of 50 degrees and then set 100 feet of flexible perforated liner. This operation was done four separate times in a five-day period without any unusual difficulty. The casing windows required less than one hour apiece to mill and each 4½-inch drainhole operation was completed without removing the whipstock and sheath pipe from the hole until after each liner was landed on bottom and detached. This well made 59 barrels per day initially and after six months is still producing 45 barrels per day while the 13-well field average at a comparable stage was less than 15 barrels per day.

A company in the Coalinga field of California has completed three of several proposed redrills by pulling the conventional liners and drilling four 100-foot drainholes to maximum drift angles. These drainholes were made using the same type of oil base rotary fluid as used on the original completions. The flexible 3½-inch drainhole liners were run in each separate bore hole, then the well was returned to production as soon as the original main liner was reset. These three wells are sustaining production 100 percent better than the various initial completions of 30 barrels per day and this improvement holds true for the field average of initial production and decline rate.

An outstanding example of horizontal drainhole technique to satisfy a remedial redrill problem has been

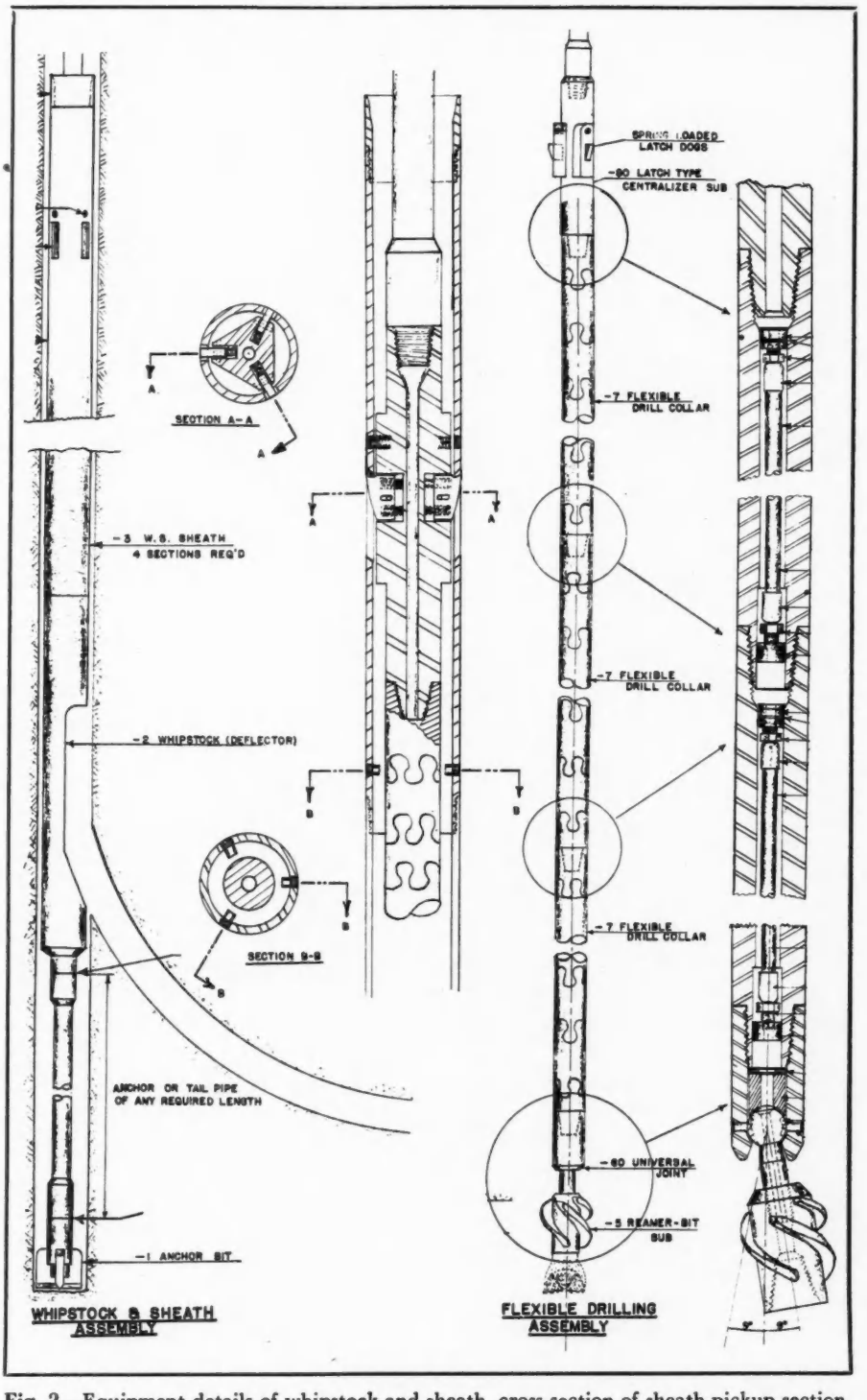


Fig. 2—Equipment details of whipstock and sheath, cross section of sheath pickup section, and cross section of flexible drill collar.

completed. The subject well was prepared for a casing window by cementing a fabricated whipstock approximately 20 feet above the 4-foot producing interval in 5½-inch, 17.5-pound, J-55 casing. The objective required deflecting away from the collapsed shale area around the liner as far as possible and then to penetrate the 4-foot zone. Using a 50-inch whipstock face, a 100-foot drainhole was completed with a flexible liner in less than two days. It is important to note that this job was done under unfavorable circumstances since the equipment used consisted of a portable production hoist, 2⅜-inch drill tubing and one small pump. At a depth of 6280 feet, the redrill rig was considerably beyond its capacity, and low circulating volumes were a great concern in the milling operation.

In the oilfield area of Fresno County, California, a well was prepared for casing redrill with drainholes. The well was originally drilled

and completed in 1926 and just prior to the drainhole operation the well was producing five barrels per day. The casing program consisted of a production liner cemented at 2109 feet to 2490 feet with eight rows of 1½-inch by ⅛-inch slots on 16-inch centers. The liner material was 9-inch, 45-pound DBX seamless casing. The casing windows were milled, as soon as the whipstock had been oriented for direction, in six hours milling time. The mill was removed and a rock bit was used to make the 100 feet of 6⅛-inch drainhole. A 4½-inch diameter perforated and flex-cut liner was then set. This operation was carried out four separate times, at different elevations, and the time consumed totalled an average of 36 hours for each separate drainhole completion.

Casing windows have been made in 5½-inch, 17-pound J.55 grade pipe up to 9-inch, 45-pound J-55 grade and this milling work has been greatly improved by using tungsten carbide mills of special manufacture. These mills, being much less expensive than their diamond counterparts, have lowered over-all costs by reducing milling time and in all cases they prepare a clean, more usable window. It can be said that for very light weights and low grades of casing, standard rock bits have been used to puncture the casing; however, this is not a recommended method.

New application. A recent and very original application of drainhole drilling equipment has been instigated in the Pine Island field near Oil City, Louisiana. This particular operation consisted of setting blank 10-foot removable sections in the completion liner interval by placing the removable sections opposite the various vertical horizons that were to be drainholed. By using acid-soluble removable sections where electrolysis is not a problem, standard rock bits can be used off of the whipstock to mill the necessary windows and then continue to drill the desired drainhole in one continuous operation.

This constitutes a great saving of rig time as drill bit and mill changes are not required. In this actual case, eight casing windows and accompanying drainholes were drilled through three blank removable liner sections, using four 3¾-inch rock bits to make a total of 560 feet of drainhole. Total liner milling time for the four windows

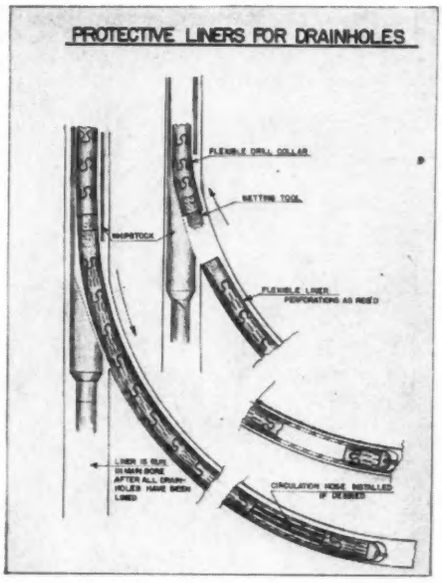

PROTECTIVE LINERS FOR DRAINHOLES
FLEXIBLE DRILL COLLAR
SETTING TOOL
WHIPSTOCK
FLEXIBLE LINER
PERFORATIONS AS REQ'D
LINER IS CUT IN MAIN BORE AFTER ALL DRAIN-HOLES HAVE BEEN LINED
CIRCULATION HOSE INSTALLED IF DESIRED

Fig. 3—Flexible liner may be equipped with circulating hose if desired, or may be left open. Liner is run with setting tool on end of flexible drill collars which engage whipstock sheath to lift it from the well.

was 11 hours and 35 minutes. Drainhole drilling time was 35 hours. Round trips, repairs to rig circulating time and standby time consumed a total of 58 hours. The over-all operation required four days and this new well was placed on production without setting drainhole liners. Three new wells have been completed in this same manner and though it is too early to make accurate production comparisons it is reasonable to conclude that this development method appears to be very successful substantiated by the initial production that in each of the three cases exceeds that of the surrounding wells in this area.

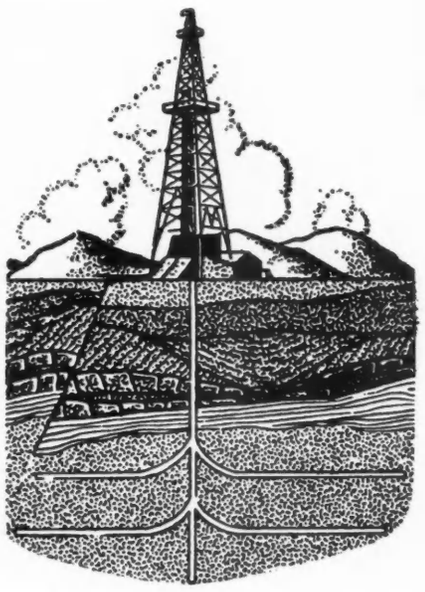
Plugging back. In regard to plug-back operations, where casing damage or excessive water has eliminated commercial production at greater depths, it is now proposed and development is progressing to use drainhole techniques in a remedial attempt before the wells are actually abandoned. These wells will be plugged above the damaged area and below the next shallower producing interval. A 150-foot drainhole will be prepared by landing a drainhole liner, perforated 30 mesh and flex cut. This liner, due to a running sand condition, will extend from the bottom of the drainhole up through the casing window to a liner seal adapter in the main casing section. This insures a continuous production assembly and this single drainhole liner method will permit re-entry of the liner for clean-out purposes.

It is anticipated that a modest increase in production will provide a great impetus to the use of drainhole equipment where plug-back prospects can satisfy the requirements of water shut-off. Remedial costs can be held to a minimum when the prospective interval has already been evaluated with regard to electric log correlation, sidewall samples and cores, and the zone already protected by cement in the original casing program. Any work of this type can be completed, at medium depths of 4000 feet or less, in 3 to 4 days total rig time.

500-foot drainhole. Flexible drilling equipment is being prepared to make it possible to drill drainholes that will extend beyond the whipstock and deflection point 500 feet. This will be accomplished at drift angles between 15 and 45 degrees. At the desired drift angle the flexible universal and stabilizer equipment will be withdrawn from the hole in order to stiffen the assembly so that the desired angle can be maintained. This method will apply where it is required to sidetrack in the steep dipping zones, in short drilling radius, then stabilizing the drainhole as it progresses down the dip of the formation.

There appears to be no limit to the manner in which these techniques can be used, either in open hole or out of 5½-inch and larger size casing. The usual drainhole liner completion has used 3½-inch to 4½-inch tube stock, perforated and then flex cut. However, gravel packs have been done in the open hole and also inside flexible liners. In hard formations, where the producing interval is known to stand up, the drainholes are produced without liners. This is especially true in the mid-continent area.

Drainhole orientation. Many questions have been raised regarding the accuracy of drainhole orientation and the degree of drift angle and directional control. Most of these questions can be explained by inspection of Figure 4 which is a schematic diagram and instructions for building and maintaining a desired drift angle. The problem of directional control is answered by realizing that drainhole drilling must naturally utilize the most advanced techniques of controlled di-



DRAINHOLE DRILLING NOW SUCCESSFULLY ACCOMPLISHED

— BUT ACTUALLY —

WHAT IS IT?

DRAINHOLE DRILLING? HORIZONTAL DRILLING?
HIGH ANGLE DRILLING? DEVIATED REDRILL?
WORKOVER? or LOW COST REMEDIAL?

ACTUALLY *ODDCO TOOLS cover the multitude of accomplishments listed above. These tools and the techniques involved in their design will place at your option a safe and economical means of drilling from the vertical bore, production holes ranging from 30° to 90°.

THESE DEVIATED PRODUCTION HOLES can be drilled from vertical open holes, milled through cased or lined holes, as follows:

Casing Size	Whipstock	Flexible Drill Collar	Size of Drainholes
5½"	4½"	3¼"	3¾"
6⅝" and 7"	5½"	4¼"	4¾"
8⅝" to 12¼"	7"	4¼"	6¼"

These drilled *HIGH ANGLE HOLES* may be produced either open or lined. Can be surveyed and/or logged. Particularly adaptable as *controlled* high angle directional drilling in areas of low pressure, low permeability, fractured limestone, fractured shale, chalks, tight sands, all of which add up to *increased formation contact* to increase production with *less acute decline curves* and a definite tie-in with secondary recovery, water flooding and injection techniques.

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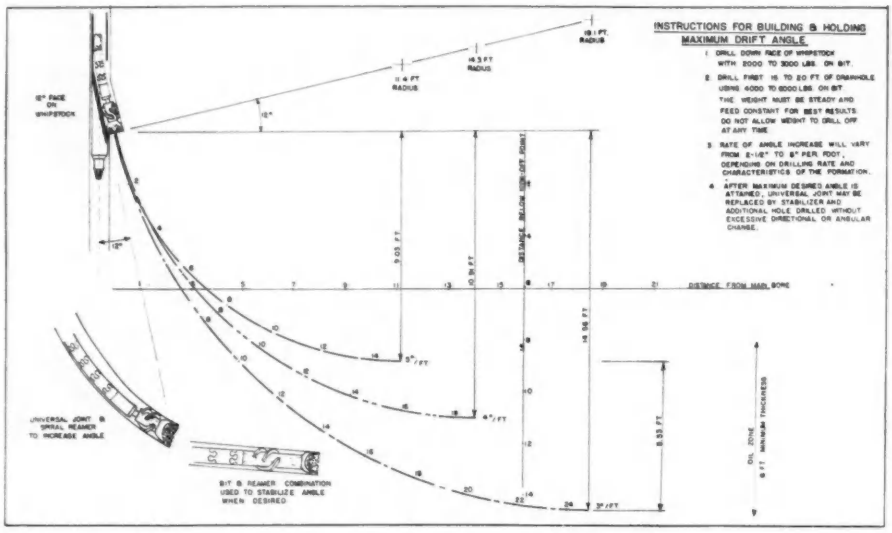
INSTRUCTIONS FOR BUILDING & HOLDING MAXIMUM DRIFT ANGLE
1. DRILL DOWN FACE OF WHIPSTOCK WITH 2000 TO 3000 LBS. ON BIT.
2. DRILL FIRST 15 TO 20 FT. OF DRAINHOLE USING 4000 TO 6000 LBS. ON BIT. THIS WEIGHT MUST BE STEADY AND FEED CONSTANT FOR BEST RESULTS. DO NOT ALLOW WEIGHT TO DRILL OFF AT ANY TIME.
3. RATE OF ANGLE INCREASE WILL VARY FROM 5-1/2° TO 9° PER FOOT, DEPENDING ON DRILLING RATE AND CHARACTERISTICS OF THE FORMATION.
4. AFTER MAXIMUM DESIRED ANGLE IS ATTAINED, UNIVERSAL JOINT MAY BE REPLACED BY STABILIZER AND ADDITIONAL HOLE DRILLED WITHOUT EXCESSIVE DIRECTIONAL OR ANGULAR CHANGE.
19.1 FT. RADIUS
14.3 FT. RADIUS
11.4 FT. RADIUS
12° FACE ON WHIPSTOCK
10°
5.00 FT.
10.91 FT.
14.146 FT.
8.59 FT.
DISTANCE FROM MAIN BORE
DISTANCE BELOW KICK-OFF POINT
9°/FT.
6°/FT.
3°/FT.
UNIVERSAL JOINT & SPIRAL REAMER TO INCREASE ANGLE
BIT & REAMER COMBINATION USED TO STABILIZE ANGLE WHEN DESIRED
DR. ZONE 8 FT. MINIMUM THICKNESS

Fig. 4—Instructions to build and maintain desired drift angle are shown above on chart which gives geometry of drainhole drilling.

rectional drilling which is already accepted in the petroleum industry.

Radical modification of tools including the 12-degree whipstock face (this face angle is varied for different hole or casing sizes) in conjunction with the short universal joint and stabilizer assembly tend to complicate the degree of control over the longer distances of drainhole. However, either bottom-hole or surface orientation of the whipstock is an accepted standard practice and total drilling control accuracy can be expected as far as 50 feet from the whipstock. Actual surveys taken in drainhole penetrations (Figure 5) illustrate the various results of length of drainhole and desired angle as compared to actual angle by survey. Calibrations have been added to show vertical distance involved in building the various angles of drift.

Results of drainhole workovers. Information was presented recently indicating results that can be anticipated from drainhole workovers.[1] Data were obtained by use of an electrolytic tank model of a reservoir. Parameters varied in the study to show their effect on productivity include the length, number and arrangement of drainholes, formation thickness and damage near the main well bore. The effect of drainhole length on productivity allows that any increase in the length is reflected in increased productivity. Where the formation has been damaged, a linear relationship no longer exists between productivity ratio and the length of drainhole. Effect of damage in the well bore region shows that both length and number of drainholes are important factors influencing increased productivity from a damaged formation. Damage is defined as any condition that exists due to casing failure, formation sloughing, sanding and/or silting in the producing interval and small magnitude faulting.

If a water-flood is to be used as a secondary recovery measure, drainholes at 180 degrees, properly oriented, may permit a close approach to a line drive type of flood. The increase obtained can make the flood much more effective. Drainholes are naturally most effective in relatively thick formations with vertical, as well as horizontal, permeability. With short drainholes (20-30 feet) the arrangement by pairs (the members of each pair at a single level and oriented 180 degrees apart) is most effective. Four drainholes placed toward the bottom of the producing interval and at right angles to each other, however, may permit better utilization of gravity drainage where this production mechanism operates. The most important results of the model study are that exceedingly large increases in productivity can be expected only in damaged wells, and that additional length (over 50 feet) is more effective than increasing the number (4-6) of drainholes.

From a theoretical standpoint drainholes increase the drainage area around a well and, therefore, will improve the initial production, if production exists, and thereby improve the rate of decline. Several research organizations have compiled profound calculations on the increase in effective drainage radius provided by various lengths and diameter of drain-holes. At present, most of these calculated conclusions must be tempered by comparisons with actual field results, and to this date few major oil companies have any drainhole records or histories of their own to work with. The small operator, who has done the

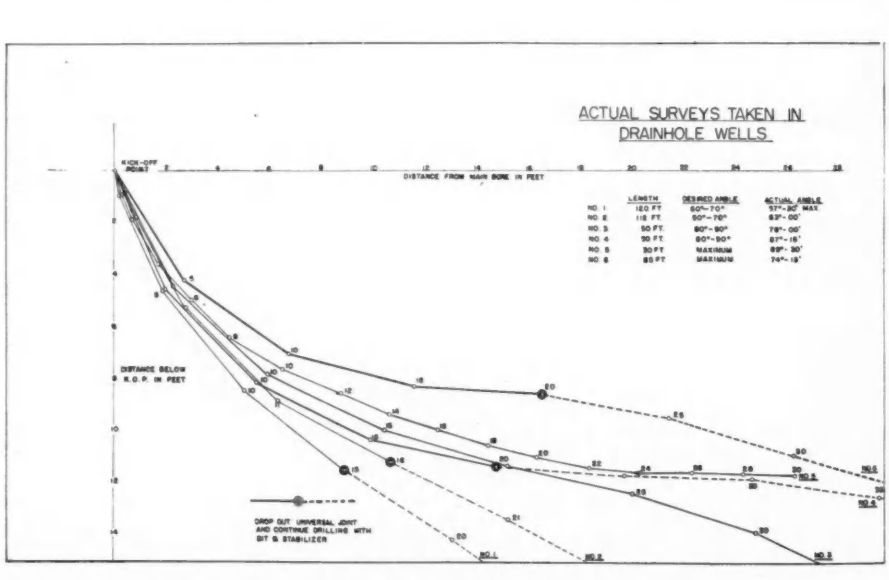
ACTUAL SURVEYS TAKEN IN DRAINHOLE WELLS
KICK-OFF POINT
DISTANCE FROM MAIN BORE IN FEET
DISTANCE BELOW K.O.P. IN FEET
LENGTH
DESIRED ANGLE
ACTUAL ANGLE
NO. 1 160 FT 60°-70° 57°-30° MAX
NO. 2 115 FT. 50°-70° 63°-00°
NO. 3 50 FT. 80°-90° 78°-00°
NO. 4 90 FT. 80°-90° 87°-15°
NO. 5 80 FT MAXIMUM 89°-30°
NO. 6 80 FT MAXIMUM 74°-15°
DROP OUT UNIVERSAL JOINT AND CONTINUE DRILLING WITH BIT & STABILIZER
NO. 1
NO. 2
NO. 3

Fig. 5—Vertical plot of actual surveys taken in six drainhole wells to illustrate the degree of close control available in horizontal drilling.

About the Author

CARL O. SPATH is vice president of the William E. Sievers Corporation. He was graduated from the University of California at Berkeley in 1942 with a B.S. degree in mining and mechanical engineering. Since that time he has been employed in the Douglas Aircraft Engineering department and then spent two years as a petroleum engineer for The Texas Company in California. From 1947 until April, 1954 he was assistant to the Pacific Coast sales manager of the Eastman Oilwell Survey Company. He is responsible for the industrial relations and engineering sales effort of the Sievers Company in representing the services of the Oilwell Drainhole Drilling Company.

major share of drainhole work, has kept few records and used practically no engineering with regard to a complete program. Any of this work, for practical purposes, must be prepared to utilize proper drilling equipment, an engineered mud program, good drilling technique, directional and drift surveys of the drainholes, and in most sand areas an engineered liner should be set to insure reasonable life for the operation. In the near future drainhole liners will be connected to the main liner. At present, most drainhole liners are set several inches away from the main bore in open formation.

With regard to drilling hazards, it can be stated that the flexible drilling assemblies used in drilling drainholes and preparing casing windows for rapid deflections have encountered no mechanical failures that would demand a change in equipment.

REFERENCE

1 "Well Productivity Increase from Drainholes as Measured by Model Study" by R. L. Perrine, California Research Corp., presented at Los Angeles, October 7, 1954, before the Pacific Petroleum Chapter of AIME.

—The End

One of the reasons Flexite plunger pumps make good production in almost any kind of well is the Flexite Ring itself. Flexite Rings are made of a special hard plastic composition impregnated with graphite for self-lubrication; they will not corrode or disintegrate, nor do they depend upon swelling for their sealing action. Flexite pumps are available in a wide range of sizes in all standard A.P.I. types, including heavy-duty models with double-thick barrel tubes for deep-well pumping. Harbison-Fischer pumps, sub-assemblies, and parts are sold from stock by supply stores in all major producing areas. Your store or one of our factory representatives will be glad to give you complete details and make special recommendations without obligation.

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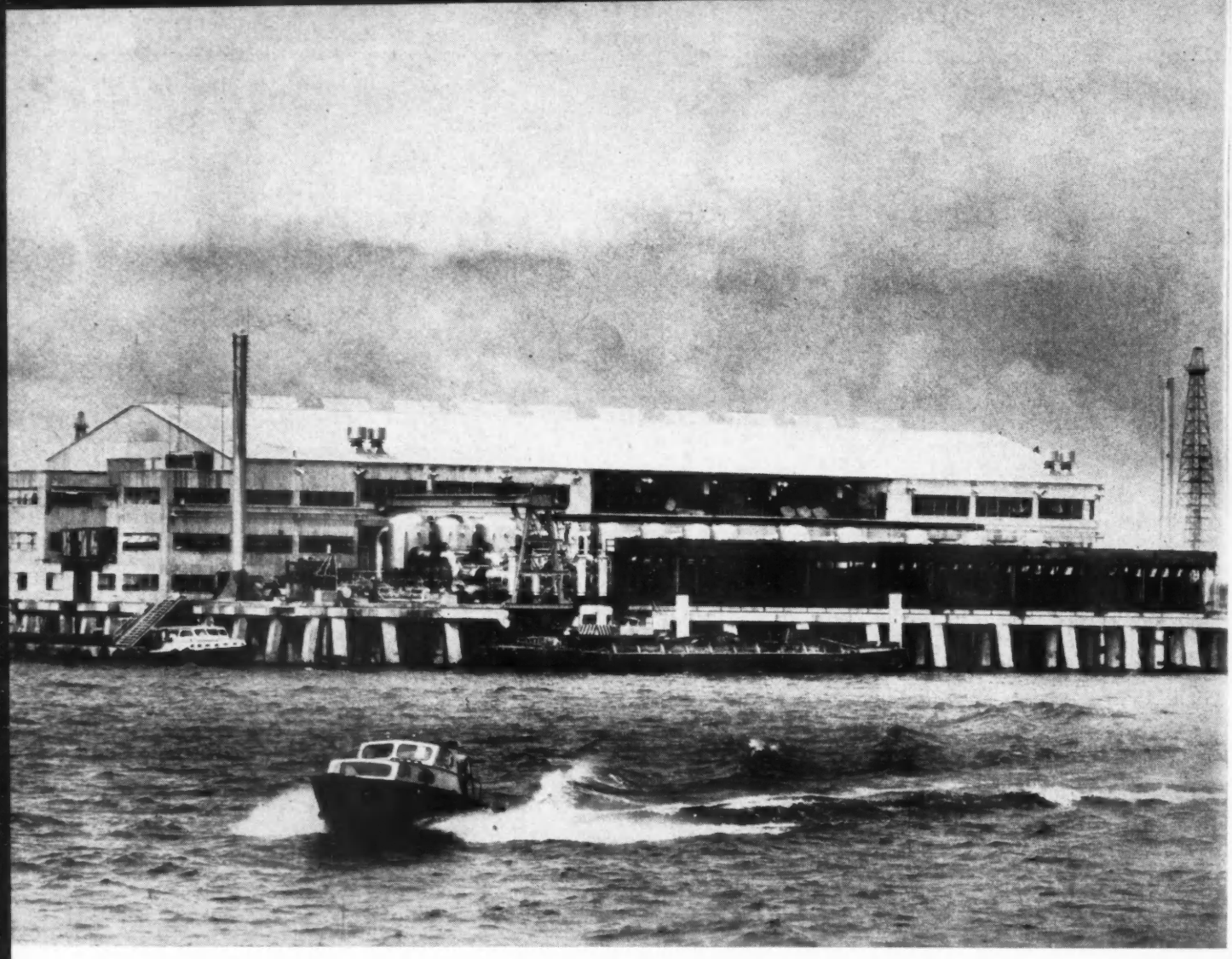

THE LARGEST COMPRESSOR STATION of its kind is located seven miles offshore in 60 feet of water and houses 60,000 compressor horsepower. The supporting concrete platform of this installation in Lake Maracaibo is nearly as big as a football field.

Giant Pressure Maintenance Project Begun in Venezuela

$20 million compressor plant dedicated by Creole Petroleum Corp., to inject 137 million cubic feet daily.

THE LARGEST pressure maintenance project outside the U. S. was put into operation recently by the Creole Petroleum Corporation in its LL-370 area of the Bolivar coastal fields of eastern Lake Maracaibo in Venezuela. The compressor plant, costing $20 million, is the largest of its type anywhere, and is unique in many respects. Completed in August, 1954, the giant Conservation Plant Tia Juana Number 1 was dedicated January 15, 1955. It is located in 60 feet of water seven miles from shore and consists of ten 6000-horsepower gas turbines driving specially designed centrifugal compressors. Approximately 137 million cubic feet of gas are injected daily at a compressor discharge pressure of 1935 psig. This is the first of several such plants planned to efficiently consume and store about 80 percent of the gas produced by Creole.

This tremendous undertaking is the result of some four years of intensive study by Creole engineers. It took 18 months to construct the concrete piling platform and the compressor station. The project is designed to gather a total of 154 million cubic feet of gas daily (17 million cubic feet of gas are required to fuel the ten gas turbines) from the producing wells in the LL-370 area. From eight nearby flow

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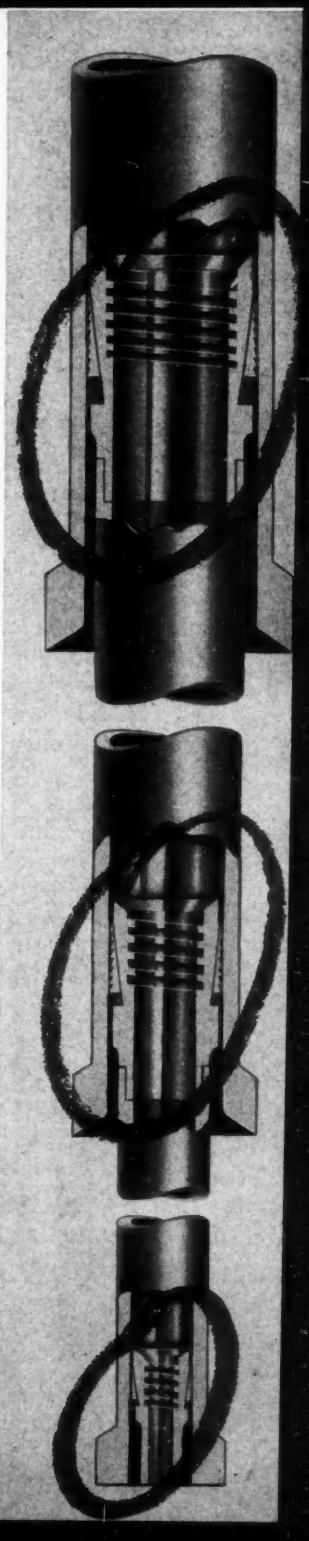
Suspend your oil string in tension and it will not collapse of its own weight — will not buckle or shift position in the well — will not sink into the bottom formation or bend into cavities. Eliminate the hazards of casing contacting the wall of the hole. Perfectly aligned casing is not subject to undue wear from servicing tools. Then too, successful cementing is assured as no time is lost in making up overlapped casing or making up extra surface circulating connections — no danger of frozen casing.

Thousands of Burns casing hangers are in use today. Available in all popular sizes. Prices on request. Check with us direct or consult a Burns distributor.



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stations, where the gas is separated from newly produced oil, it is carried to the new plant through five 30-inch pipe lines at a pressure of 25 pounds per square inch gage.

Of the total volume gathered each day, it was estimated that some 17 million cubic feet would be burned as fuel and condensed to liquids. The remaining 137 million cubic feet would be compressed to 1935 psig and returned through five injection wells to the producing formation.

The pre-design study indicated that the gathering of the gas to a gas combustion-turbine powered centrifugal compressor station located in the weighted center of the field, was preferable on all counts. The decision to use such a system was quite progressive since experience with gas-fired combustion turbines was limited, and at the time no large installation of centrifugal compressors had been made for compressing natural gas above 1000 psig. On the basis of the studies, the project was held to be feasible and economically attractive.

The installation of a gathering system to handle large volumes of gas at low pressures was one of the unique problems that had to be overcome. The gathering system lies on the lake floor at depths of from 62 to 65 feet. Based on optimum pressure drop, it was determined that the economic line sizes should range from 24 to 30 inches in diameter. Some 65,000 feet of 24-inch, 26-inch and 30-inch pipe were actually laid. Protection of the pipe against the corrosive effect of the brackish lake water and the teredos (marine termites) that exist there, plus the necessity for added weight to secure a negative buoyancy, required special preparations. The system devised was to coat the pipe with asphalt, wrap it with glass cloth and then with heavy wire mesh, and then to cast some 4½ inches of concrete around it. This provided an average negative buoyancy of about 15 percent. The preparation and placing of this extremely heavy pipe (562 pounds per lineal foot for 30-inch pipe in sections up to one mile in length) in 62-65 feet of water was in itself a major undertaking.

The fact that lines of such large diameter could not successfully be cleaned by flowing, that the interior pressure of the gas would be less than the exterior water pressure (with the consequent entrance of water on development of breaks or leaks) and the impracticability of installing and operating "line drips," required extensive measures to prevent the entrance of liquids into the gathering lines, and to remove such liquids when inadvertently admitted.

The high-pressure gas injection system consists of four 6-inch lines and one 8-inch line originating from the compressor station and terminating at each of the five injection wells. Schedule 80 pipe was used, and the total length of injection line is about 41,000 feet.

Seven stages of compression. Seven stages of compression are provided. The first stage requires the capacity of three compressors connected in parallel to handle the large gas volume at the low plant intake pressure (25 psig). Two parallel-connected compressors form the second stage, while the remaining stages have one compressor each. Intercooling and interstage condensate facilities are provided between each of the stages. Provision is made for the interstage condensate to be stabilized and pumped to the nearest flow station for blending with crude. Prior to delivery to the injection lines, the seventh stage discharge is cooled. Any entrained or condensed water is removed at this point to lessen corrosion which might result from combination of the water with carbon dioxide contained in the gas, and to prevent slugs of water from returning to the formation.

The ten two-shaft turbine drivers, selected to secure maximum flexibility in speed variation, represent the largest concentration of gas combustion turbines in the world. The turbine air compressor will operate at 7500 revolutions per minute and the power rotor normally at 5400 RPM, with "overspeed trip" at 6000 RPM.

The first three compressors are cast iron horizontally split type, the next three are cast steel horizontally split type and the last four are forged steel vertically split barrel type. Any single turbine-compressor unit can be isolated from the system without shutting down the plant. The estimated decrease in throughput with a compressor out of service will vary from 8 percent for a first stage compressor to some 25 percent for a sixth or seventh stage compressor.

Complex control system. The complex control equipment of the plant is designed to take care of the multiplicity of coordinated and interlocking steps required to start and operate its high speed machinery, to protect each compressor from surge conditions, to isolate immediately a faulty turbine-compressor unit from the system and to secure a maximum of safety. Three of the four major control systems work in conjunction with each other in interacting and/or overriding manner, while the fourth is a three-way pressure relief system. Aided by this extensive instrumentation, the compression system will permit operation of the plant with a minimum of personnel and at greatly reduced maintenance costs.

The plant is well equipped with an instrument shop, a mechanical maintenance shop for small work, six offices, change-shower rooms and a dining room. Communication with the shore is by radio-telephone and through the plant itself by an intercommunication system.

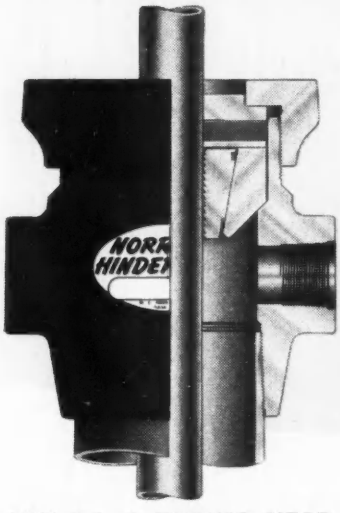
The producing reservoir. The productive horizon into which gas will be injected was discovered in 1939 by well LL-370 and is composed of the B-6-X Eocene sands. The subsurface reservoir is a permeable rock slab saturated with oil and about 200 feet thick, consisting of 85 percent sandstone and 15 percent shale. Top of the oil reservoir, at 4500 feet below the lake surface, is sealed off by the Miocene-Eocene unconformity and the bottom is bounded by immobile edgewater at 5850 feet. Two large faults define the side boundaries. The structure dips a gentle three degrees to the southeast and the total productive area involved is approximately 9800 acres.

This deposit is similar to all major oil accumulations in the Bolivar Coastal field in two characteristics: (1) it has no active water influx at the bottom, and (2) it originally had no gas cap at the top. Production during the early years was entirely by solution gas drive. By 1950, a secondary gas cap formed by gravitational segregation had reached the structurally highest wells. It was apparent that even without artificial pressure maintenance, considerable increases in oil recovery above that to be expected by dissolved gas drive could be ob-

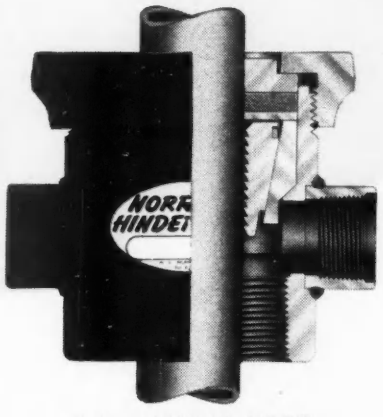
STASH COMPLETION TROUBLES

with

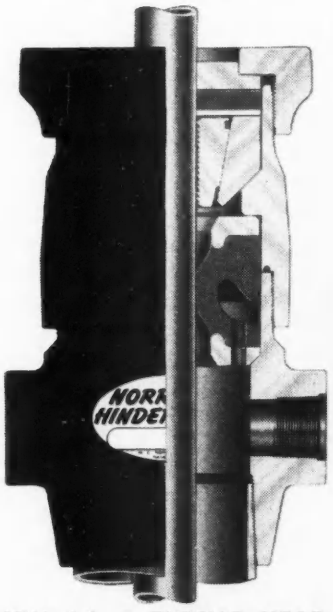
NORRIS-HINDERLITER *WELL* DEVELOPED WELL HEAD EQUIPMENT



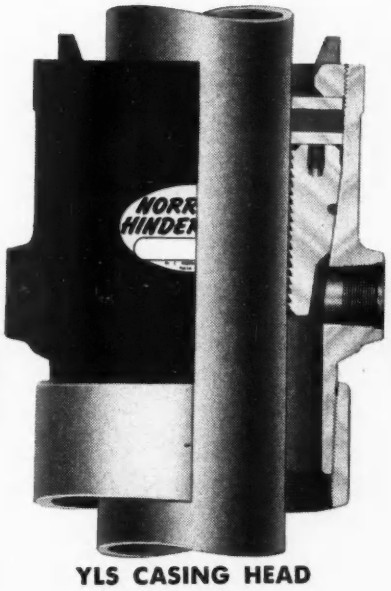
HW 2-in-1 TUBING HEAD
4000# Test Pressure
2000# C.W.P.



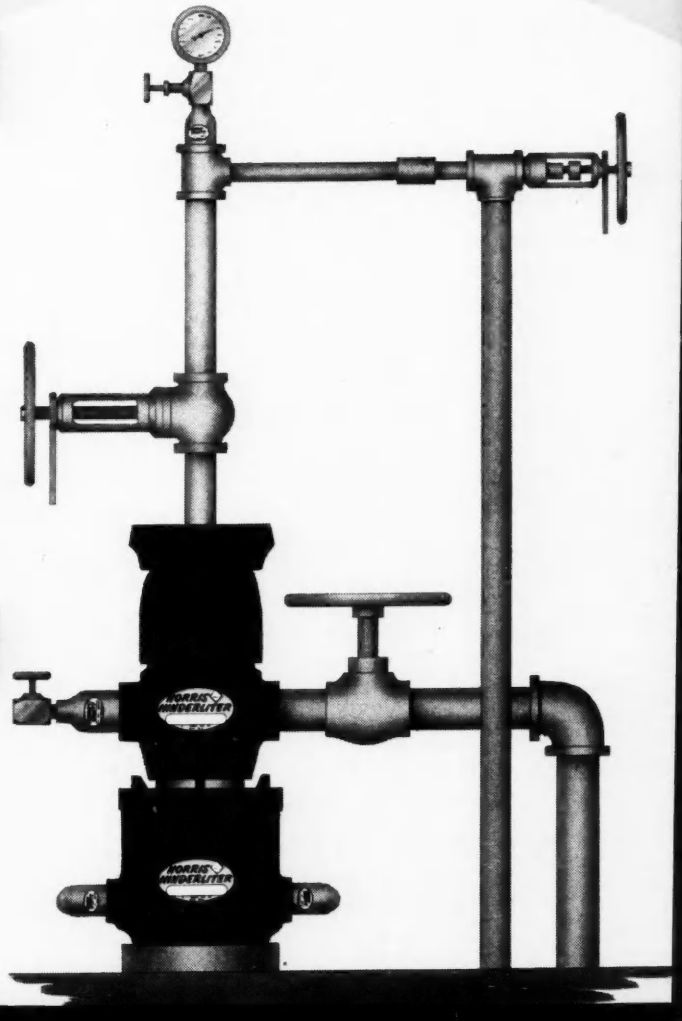
WCN TUBING HEAD
2000# Test Pressure
1000# C.W.P.



HW 4-in-1 TUBING HEAD
4000# Test Pressure
2000# C.W.P.



YLS CASING HEAD
2000# Test Pressure
1000# C.W.P.



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RETAINER PRODUCTION PACKER..

What is a Permanent-Type Well Completion?

HERE ARE THE FACTS:

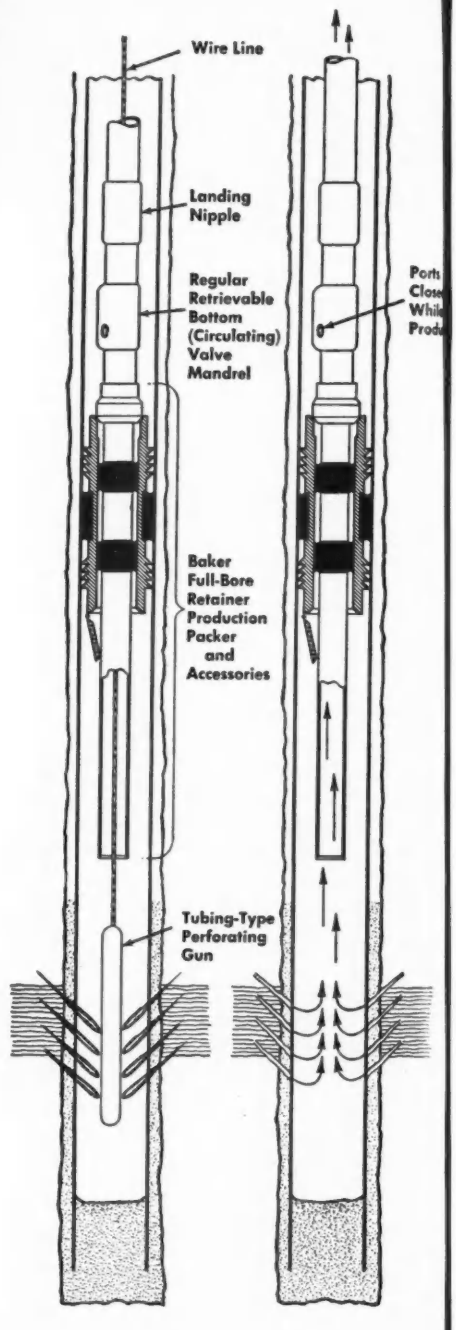
A Permanent-Type Well Completion is generally considered to be an installation providing for completion, production, repair or recompletion in other zones without requiring a drilling or work-over rig.

All tools are run *through the tubing string* after it is landed and nippled up.

If the completion is successful, the tubing need never again be moved until all zones of the selected interval have been exhausted.

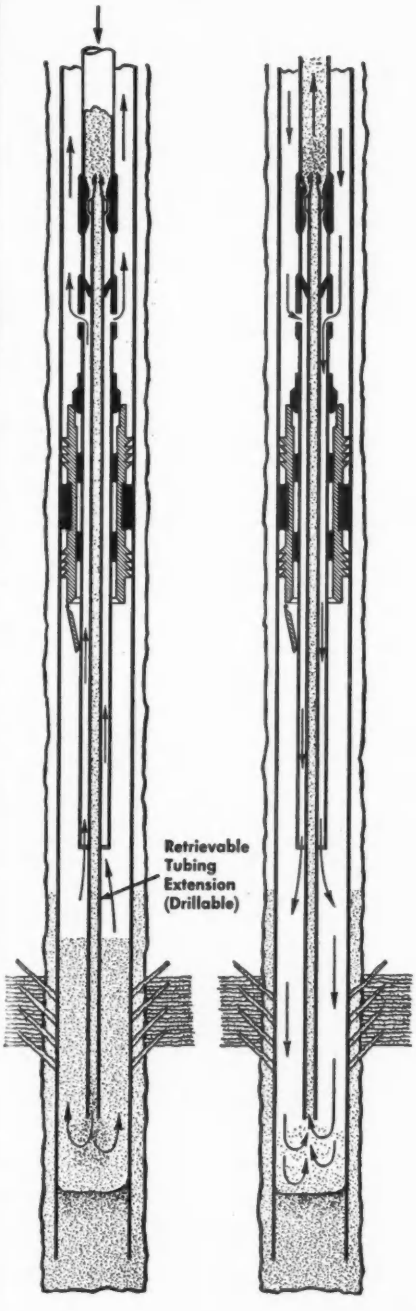
Advantages Claimed for Permanent-Type Well Completions

1. **SAVES AT LEAST ONE TO TWO DAYS RIG TIME during the original completion.**
2. **ELIMINATES COST OF SEPARATE TESTING AND SQUEEZE TOOLS.**
3. **REDUCES WORK-OVER COST AS MUCH AS 75%, by eliminating work-over rig, cost of mud, time and equipment to kill well. Reduces loss of production through saving in work-over time.**
4. **PERMITS THE ECONOMICAL TESTING OF THIN OR QUESTIONABLE SECTIONS.**
5. **PERMITS USE OF WATER INSTEAD OF MUD while perforating completing, or re-completing. This practice reduces formation contamination and may result in an increase in the productivity of the zone.**
6. **PERMITS A MORE ACCURATE ANALYSIS OF RESERVOIR POTENTIAL.**
7. **KEEPS WELL UNDER CONTROL AT ALL TIMES.**



Where PACKERS are required . . . specify a . . .

...for Permanent-Type Well Completions

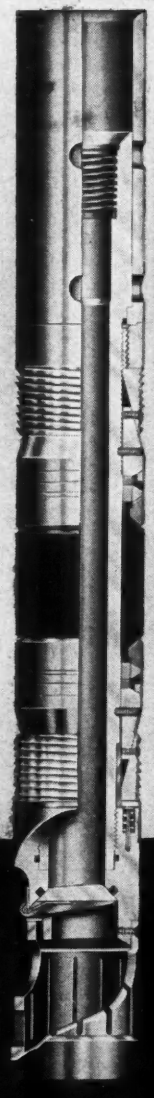


SQUEEZING REVERSING

BAKER PACKERS ADD PERMANENCE TO PERMANENT-TYPE WELL COMPLETIONS

When you select a Packer for a Permanent-Type Well Completion, remember this fact: of all the tools used in permanent-type well completions, only the *Packer* is required to be *permanent.* Guns, Extensions, Plugs, Gas-Lift and Circulating Valves can be removed or replaced on wire line... but the Packer, like the casing, is required to perform for the life of the selected producing intervals.

Baker Packer Completions are Permanent Completions from the standpoint of packer performance. Check these important advantages of the Baker Packer in Permanent-Type Well Completions:



Advantages of Baker Retainer Production Packer in Permanent-Type Well Completions:

1. **PERMANENT, RELIABLE PACK-OFF will hold against any pressure differential from above or below that is safe for the casing.**
2. **FREE TUBING STRING . . . neither set-down tubing weight nor tubing tension required to achieve and maintain pack-off. Tubing can be anchored to Packer if desired.**
3. **CAN BE USED AS A SQUEEZE OR A PRODUCTION TOOL.**
4. **MEETS PERMANENT-TYPE WELL COMPLETION DIMENSIONAL REQUIREMENTS.**
5. **CAN BE SET ON WIRE LINE.**
6. **PERMITS EASY REMOVAL OF TUBING STRING.**
7. **READILY DRILLABLE IN CASE OF EMERGENCY OR NEED.**

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RETAINER PRODUCTION PACKER

PRODUCT NO. 415-D

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tained by assisting the gravitational segregation and secondary gas cap development. In short, the reservoir was performing efficiently as a natural gas oil system except for the declining pressure and accompanying undesirable changes in fluid properties.

During the development of the reservoir, the importance of obtaining cores from the productive formation was recognized, and in many wells cores were obtained throughout the productive interval. Characteristics of porosity, permeability and fluid saturation were determined. All properties of the reservoir fluids were checked to obtain accurate data on the oil characteristics. Analysis of all this information was the initial step undertaken by Creole four years ago.

Average permeability is about 1000 milidarcys, and the sand is preferentially oil wet. Gravity of the well varies throughout the productive section. At the base of the sand, gravity of the oil is 18 degrees API; at the top, it is 28 degrees API. Gas-oil ratios are about 970. Current production from the field is 60,000 barrels per day, while the cumulative production to June, 1954, was approximately 192,000,000 barrels. In view of the complicated reservoir calculations involved and variations in the producing sands' characteristics and fluid content, estimation of the recoverable oil under various development programs required ten man-years of work.

Behavior of the reservoir in future years was estimated under three different conditions: (1) production by natural forces, (2) production by pressure maintenance with gas injection, and (3) production by pressure maintenance with water injection. Gas injection was decided on as the most advantageous.

As a result of the operation of the new plant, the following major benefits are expected:

1. The wells in the area will continue to produce by natural flow.
2. A large volume of gas will be conserved.
3. Producing rates of the field will be increased by nearly one-half.
4. The amount of oil recovered from

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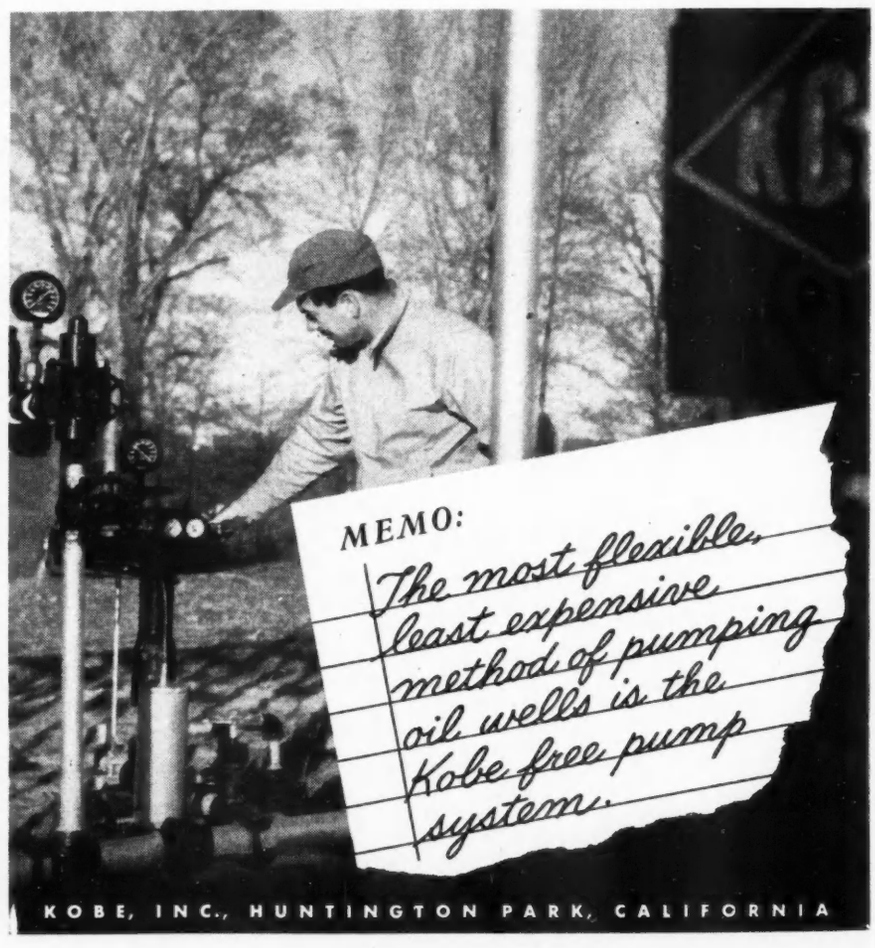

KOBE, INC., HUNTINGTON PARK, CALIFORNIA

the reservoir will be increased by about one-third.

Platform of concrete piles. Construction of the plant proper was begun in August, 1953, after the platform had been erected upon foundations driven into the lake bed. These foundations consisted of reinforced concrete piles, 28 inches square and 165 feet long. The piles were prefabricated at Creole's casting yard on shore. They represented a substantial saving over the caisson-type piles previously used in water of this depth. A total of 350 piles supports the platform, which is 329 feet long and 143 feet wide. The platform stands 14 feet above the water and some 80 feet above the lake bed. In areas required to support concentrated weight, the piles were driven to "no go" with the application of 200 tons of weight. A minimum of 72 tons was applied to piles in less critical areas.

Pre-casting on shore of the beams, floor sections and the ten turbine-compressor support boxes (130 tons each), and the subsequent integration of these into the platform resulted in savings of materials and construction time.

The platform design called for maximum economy of space.

Construction work at the plant was completed in August, 1954, and the first trial operations were effected in late September. In October, injection of gas was started.

Transportation of plant personnel is handled by diesel-powered launches operating from Creole's shore installations.

BIBLIOGRAPHY

"Giant Venezuela Pressure Maintenance Program Planned," WORLD OIL, April, 1953, pg 278.

—The End

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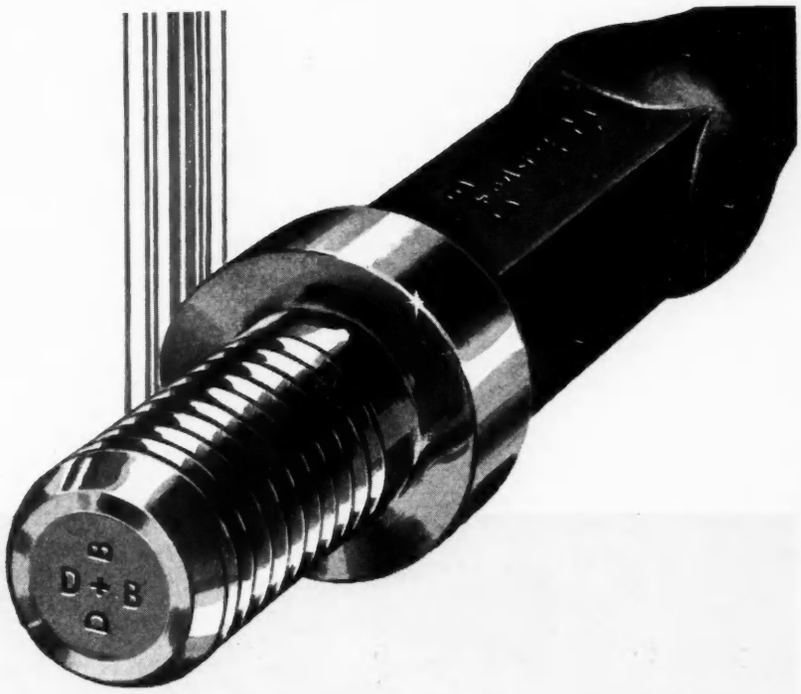
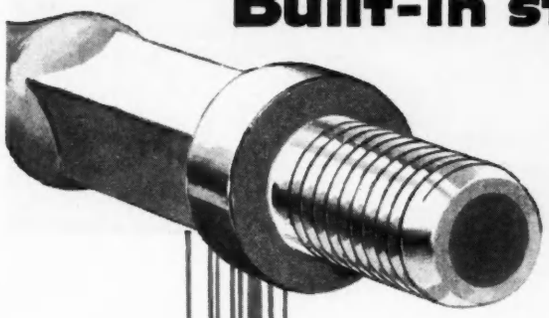
The complete editorial index covering all issues of WORLD OIL published during 1954 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to *all subscribers* who write requesting copies. All you have to do is to refer to the Reader Service blue postcards (on Pages 225-226), fill in your name, company, position and address and add the words: "Send Index." Mail the postage prepaid card and the Index will be sent you.



Built-in strength



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PRODUCTION HINTS

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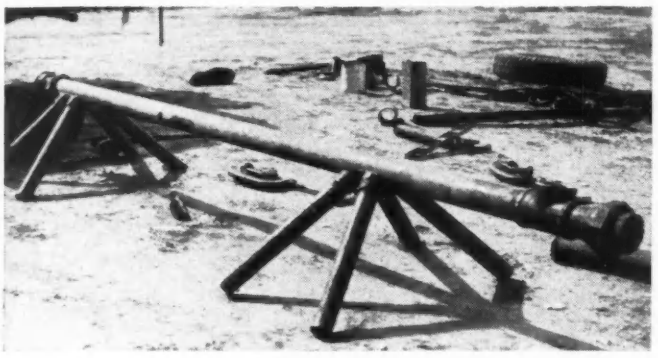
Make Pipe Stand of Heavy Horses

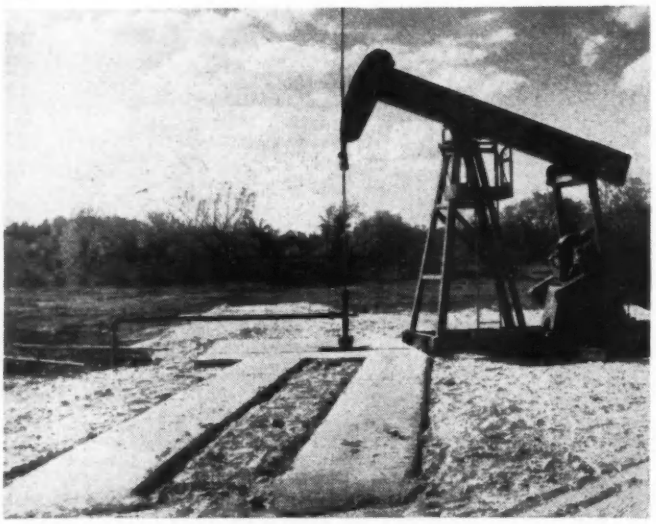


Portable horses or supports as commonly used by field personnel oftentimes are so high off the ground that heavy bucking-up required on large, or high-pressure fittings is difficult. To facilitate this heavier work, also to more easily adapt supports to longer lengths of pipe, one company built two four-legged "horses" which are easily and quickly set up or disassembled for easy transportation and which are sufficiently sturdy to allow heavy bucking-up and threading to be done.

Each support consists of a short half-section of casing to which are welded four two-inch pipe collars, the latter positioned so that when the two-inch pipe legs are attached, the latter will form a broad base; one that has exceptional stability on almost any type of terrain. The units illustrated, when mounted, places the work only about two feet above the ground—a level that permits easy attachment of a power threading attachment taken off the rear wheel of the field truck; also is at a level at which a man can bear down on a wrench without straining or "reaching." At that level, also, a 24- or 36-inch wrench back-up can be dropped to the ground for the final making-up of tight fittings; the broad base preventing any possibility of the stand tipping over.

Ease of disassembling and transporting the units and their adaptability to nearly any field condition will repay their original cost many times over.

Ribbon Slab Gives Adequate Support

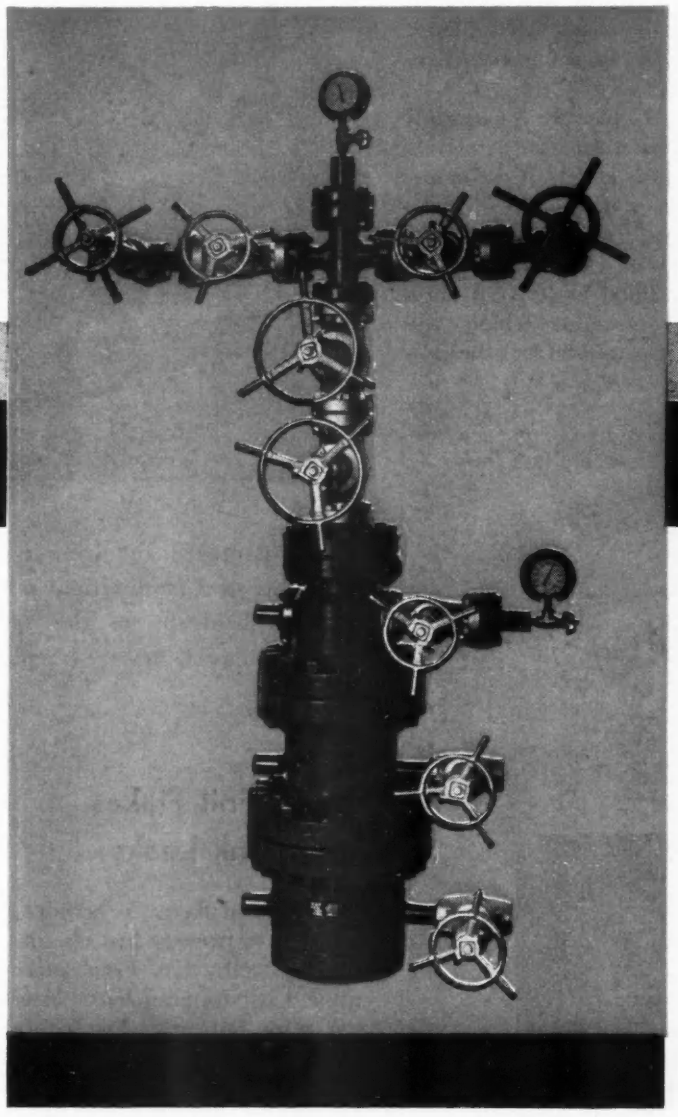


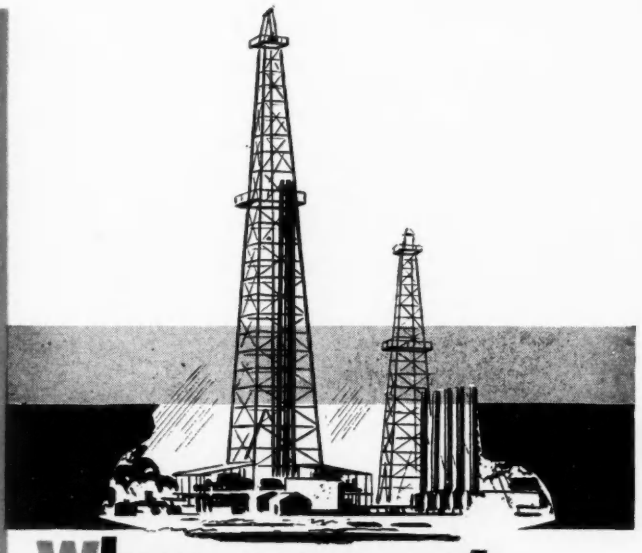
The least expensive and easiest slab to pour around a completed well is that of the apron surrounding the christmas tree and the ribbon strips for the pulling unit. In an area where the expected life of the well is relatively short, one operator did not go to the added expense of pouring the expensive slab foundation for the pumping unit. Instead, the pumping unit skid was supported on creosoted timber.

However, when the well is expected to be worked over at frequent intervals, it is desirable to make provisions for the pulling unit. A simple ribbon slab, as shown, is poured on top of the ground to give the footing needed for the unit. A slab can be poured on top of the ground around the wellhead to make it more convenient to work on the well. Should the pumping unit be moved and the well abandoned, little expense is involved in loading the unit, breaking up the concrete slab and clearing the location.

Landing Mat Material Makes Cellar Covering

An item that represents a modest outlay of time and materials when a new well is completed is the plank flooring which normally covers the cellar surrounding the wellhead. Not only must a carpenter saw and hand fit each length of the heavy 3 by 12 planking, but subsequent maintenance often becomes a problem. One operator learned that he could save a con-





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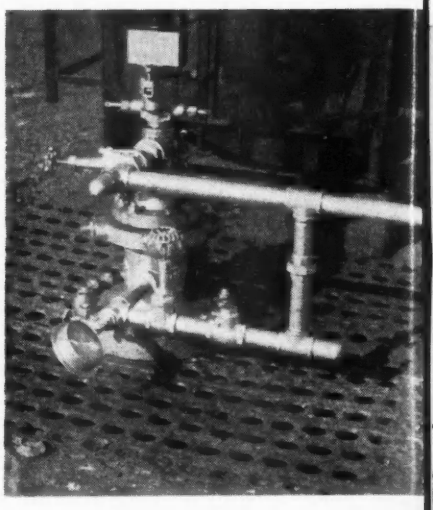
siderable amount of this initial as well as subsequent maintenance cost by using the perforated, non-skid landing mat material used during World War II in the construction of overseas landing strips. This material, commonly available in war surplus stocks, easily can be cut into the desired shape by the welder and the hole needed for the wellhead easily cut out with a torch. Layout of the landing mat material can be arranged so that the strips, when placed side by side, can be removed whenever necessary.

This material, having remarkable strength considering the relatively thin material of which it is made, easily supports a man; provides desired ventilation for the cellar, yet permits easy removal whenever access must be gained to cellar fittings. Unlike plank material which will wrap and in time splinter or otherwise become damaged requiring replacement, this steel landing mat material lends itself ideally to this type of service and need never be replaced.



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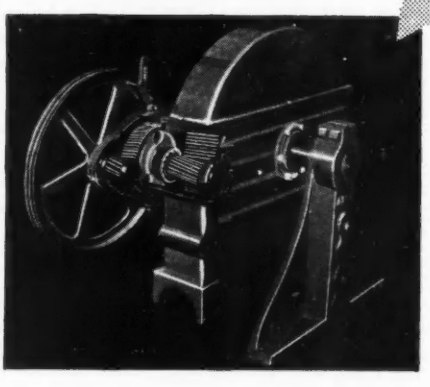

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Heavy welding on base, post and beam—double tapered roller type bearings—precision shaved gears—oil bath lubrication—are a few of the many other features that add to the economy and efficiency of JENSEN JACKS. Write us a card or letter for complete information, or see your JENSEN Dealer!

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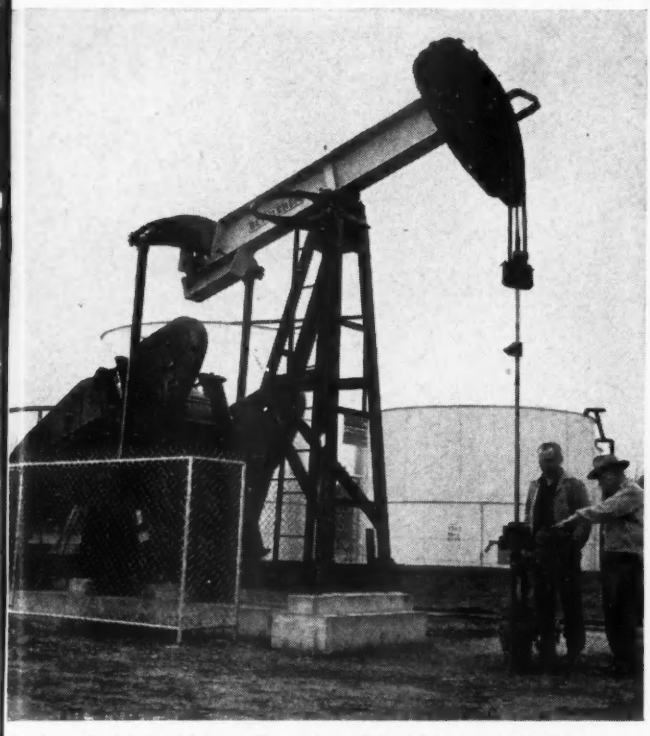
Plastic Foil Flakes Plug Tank Leaks

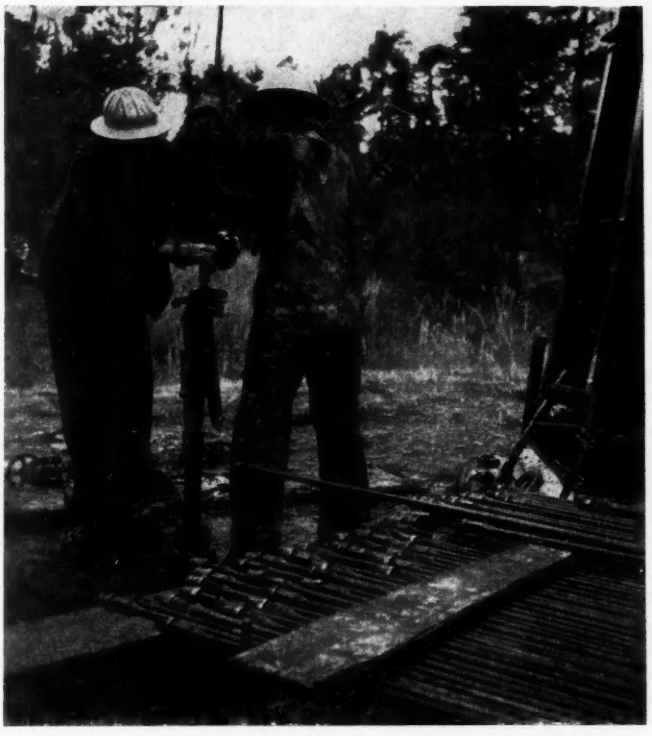
Plastic foil flakes, originally manufactured to prevent lost circulation in drilling wells, has been successfully applied in stopping leaks in oil storage tank bottoms. The contents of one 25-pound bag can cover over a half-million square inches, therefore very little of the material is required in most cases.

The plastic foil flakes are first mixed with a carrying agent, preferably oil from the stock tank. It is desirable to place this mixture as near the area of leaks as possible. Therefore, if the bottom is leaking, it might be necessary to pump into a connection on the drain line. In any event, a pump is necessary in order to place the oil-foil mixture into the tank. If there are no connections near the bottom on which to tie a line, it may be necessary to extend a section of one-inch pipe through the thief hatch on top of the tank. In this manner, discharge of the material through the one-inch line can be directed anywhere on bottom desired.

Previous experience has shown that leaks are not stopped immediately, but that a complete shutoff of a leak is usually obtained in about a week after the plastic flake material has been applied.



Equipped with Bethlehem X2 rods and Bethlehem 114D-14SA automatic pumping unit, this Shell Oil Company well produces 39-40 gravity oil from Woodbine Sand.



Making up the string. The Bethlehem X2 rod is a carbon-manganese rod, and is fully normalized. It is ideal for heavy-pumping duty in non-corrosive wells.

X2 RODS PUMP FIELD WELL IN EAST TEXAS

George Barnes (without hat), of Shell Oil Company, discusses Bethlehem package with Bruce House, Bethlehem Steel Company representative. The Bethlehem unit package saves handling time because it is made up of either 80 or 100 rods, and can be lifted by means of gin-pole truck and lifting rig.

Steady, dependable pumping is being obtained in the J. B. Watson lease No. 37, a 3600-ft well near Kilgore, Texas. The well is operated by the Shell Oil Company, and is pumping from the 2000-ft level. It is producing 20 bpd allowable of 39-40 gravity oil from the Woodbine Sand.

The well is equipped with a Bethlehem 114D-14SA, Series 50 automatic pumping unit. The sucker rod string is made up of Bethlehem X2 carbon-manganese rods, fully normalized.

Operators can always be sure that, for normal well conditions, there are no finer rods than those made by Bethlehem. For Bethlehem rods come in carbon or alloy in five types, each designed for a specific kind of pumping duty. We make a full line of sucker rod accessories, too. If you would like complete information, drop a line to the nearest Bethlehem office or sucker rod distributor.

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BETHLEHEM STEEL

Designed for Maximum Safety and Convenience in Operation

The Ratigan No. 212 Blowout Preventer is manufactured of high-pressure electric steel with 3000 lb. capacity, although comparatively light in weight, it affords maximum safety to men and equipment. It can be used for swabbing or running rods in wells that head, or flow, in course of operations. The Ratigan No. 212 Blowout Preventer is equipped with the latest type retractable rubbers . . . simply unscrew the plugs at each end to change. The "212" is manufactured in 2", 2½" and 3" sizes. The 2" and 2½" sizes are supplied both plain and upset and can be furnished in male or female or double female. The 3" size is supplied in male and female only.

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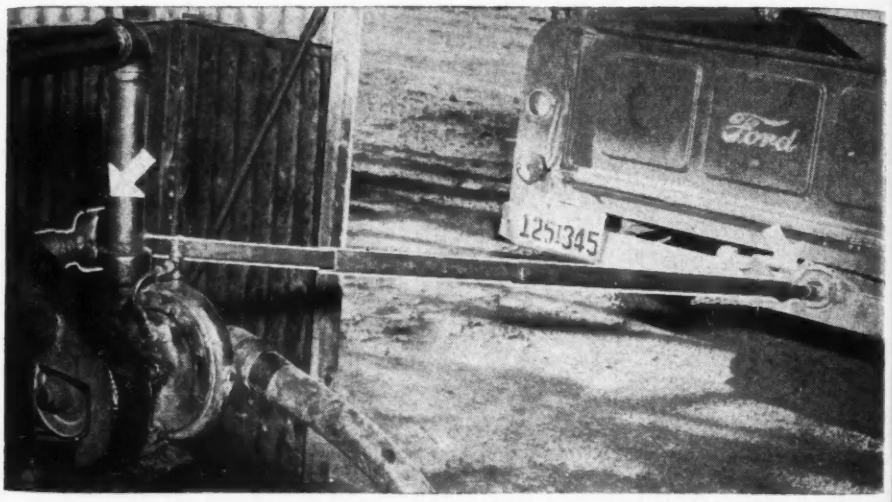

Photo courtesy *SUNRAY NEWS*

Truck Power Take-off Starts Engine

The back-breaking and sometimes dangerous task of starting large internal combustion engines has been solved by a unique hook-up involving a power take-off from a pick-up truck. The unit would not be justified for just one engine, but since several are involved, this device has more than paid out in time saved and eliminating manual starting.

This engine starting device consists of a telescoping drive shaft, the cross-section of which is square or box shaped. It is equipped with two universal joints; one at either end.

A power take-off assembly is mounted in the truck rear bumper as indicated. This unit can be covered with a plate when not in use. The other end of the drive shaft is fitted with a rachet drive cog which fits snugly over the crank shaft.

The pumper or mechanic backs the pick-up truck up to the engine to be started and hooks up the telescoping drive shaft with universal joints in the manner shown. With the truck engine running, the power take-off gear is engaged, thereby transmitting rotation to the engine crank shaft. As the engine starts, the rachet cog slips over the drive pins and the drive shaft becomes disengaged. The complete unit is easily carried, light in weight, and quickly set up for use.

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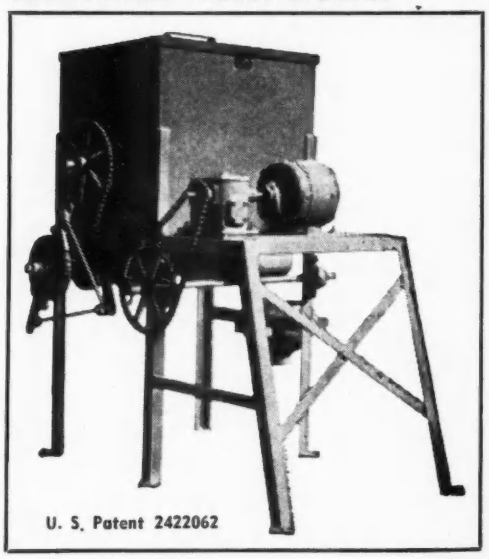

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For complete description see Page 2630 of the Composite Catalog.

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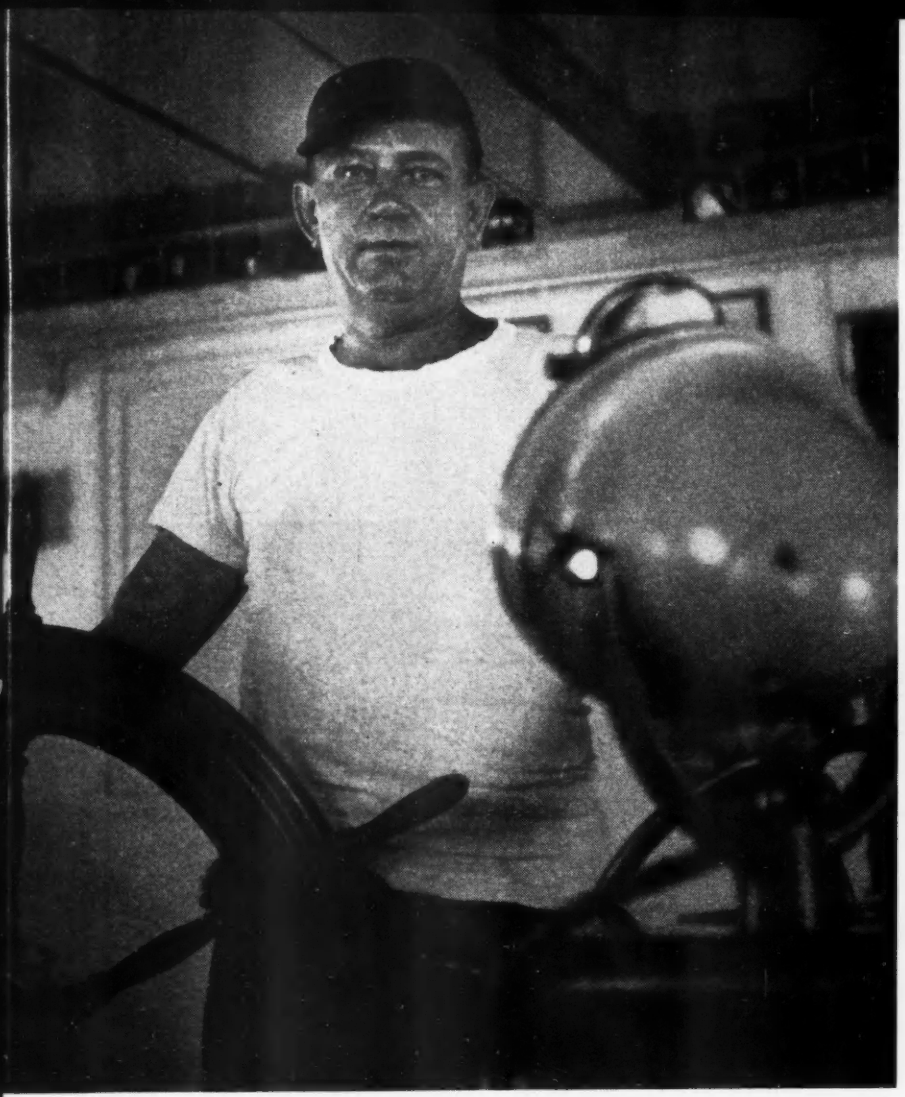


THE ACTING QUARTERMASTER takes his turn at the wheel as the tanker heads out to sea with a cargo of petroleum products.

A CAMP CITY PROFILE

Tanker Men Are Proud Men

From three desserts to chipping and painting, life on a "floating camp" has its rewards.

By GEORGE N. HEBERT

OUT ON A roughhouse sea are the lonely sea lanes traveled by oil-laden tankers bound from Boston to Borneo, from Nome to Samar—from edge to edge of a world dependent on their cargoes.

Out there, beyond sight of land, one finds more than just sailormen in a tall ship with but a star to steer her by.

Welded steel muscle and hardwood brawn make a present-day craft a worthy opponent for the sea. Her brain and nervous system are her officers and crew. Her hull contains not only facilities for handling thousands of barrels of petroleum products but also comforts and conveniences of any modern settlement catering to the needs of 42 hard-working men.

Her builders have denied her nothing. Every effort has been made to make life comfortable aboard the tanker, in compensation for long periods of time spent away from shore homes.

Tanker men take pride in their floating camps. They consider their's an idyllic existence.

One oldtimer almost hoisted his storm flags when mention was made of the possibility of conflict between such varied personalities living together in such a small area; of the danger of monotony when performing shipboard chores; of the loneliness of it all.

"Heck," he spat, "we're just people! Our jobs are just jobs. Sure, they move with us over several thousand miles of water but they're no more monotonous than those any other man works at day after day.

"Lonely? Reckon a man could get lonely if he worked at it. If he didn't enjoy genuine companionship; if he didn't like television or never listened to the radio; if he refused to play cards or checkers or any other interesting game; if he wouldn't enjoy reading . . . then, maybe he would be lonely.

"Of course everyone misses home and family. But we miss them no more than a drilling crew on an offshore rig would miss theirs. No more than a construction worker who must follow jobs all over creation. No more than any man who signs up for foreign work with any one of hundreds of companies doing business in other countries. No more than a salesman who must be away for two or three weeks each month.

"We miss our folks but there's plenty to do aboard ship. Plenty of things which shorten the time between ports."

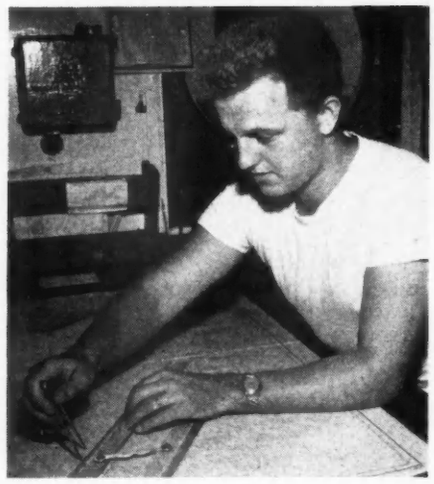
Life on a tanker combines—in a relatively small space—the pleasures and comforts of any all-male spread or location. Crew quarters are a far cry from the old days. Two crewmen occupy a single room. A bright room, furnished with beds, a desk, a big lounge chair and a folding wall couch. Officers have private staterooms and a private bath.

There's a hospital room for any

Take a trip on a tanker . . .

Loading for another run

Checking ship's position

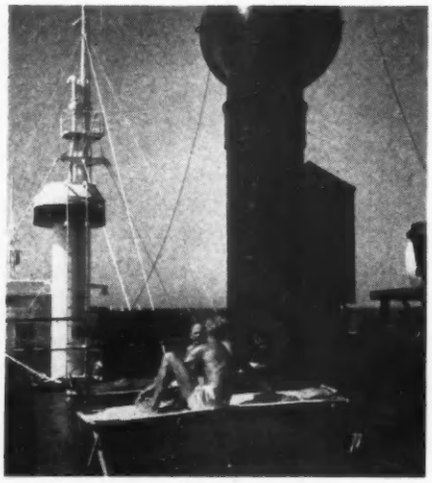


Plotting the course

Peeling potatoes, too

Chow time at sea

Deck crew at work



Sunbathing on deck

Painting pilot house

Loading for return trip

This feature, one of a series describing important oil camps or cities throughout the world, is intended only to describe living conditions and to give a bit of the local atmosphere. While an occasional one of the features may touch lightly on working conditions, it will do so only incidentally.

treatment required. The first mate passes a rigid first aid test when getting his license and the Skipper must pass one even tougher. They are qualified to handle routine accidents and emergencies.

Two mess rooms are operated for officers and crew. To the starboard, officers order from the same menu being used in the port side mess by crew members. An ordinary seaman-waiter brings the very best food money can buy to satisfy healthy appetites whetted by salt air.

The steward plans the menu which includes three meat dishes, five vegetables, three salads and two or three desserts. The diners are not restricted to "choices." They select what they want to eat, but they can order everything on the bill of fare and order it often as they like.

After a hard day's labor and a hearty meal, tanker men seek out smoking areas, the lounge room or will tune up on musical instruments for a good old-fashioned jamboree. Portable radios are switched on and the television set is adjusted to the channel which corresponds with the area in which they happen to be. Life "shoreside" isn't too far away, after all.

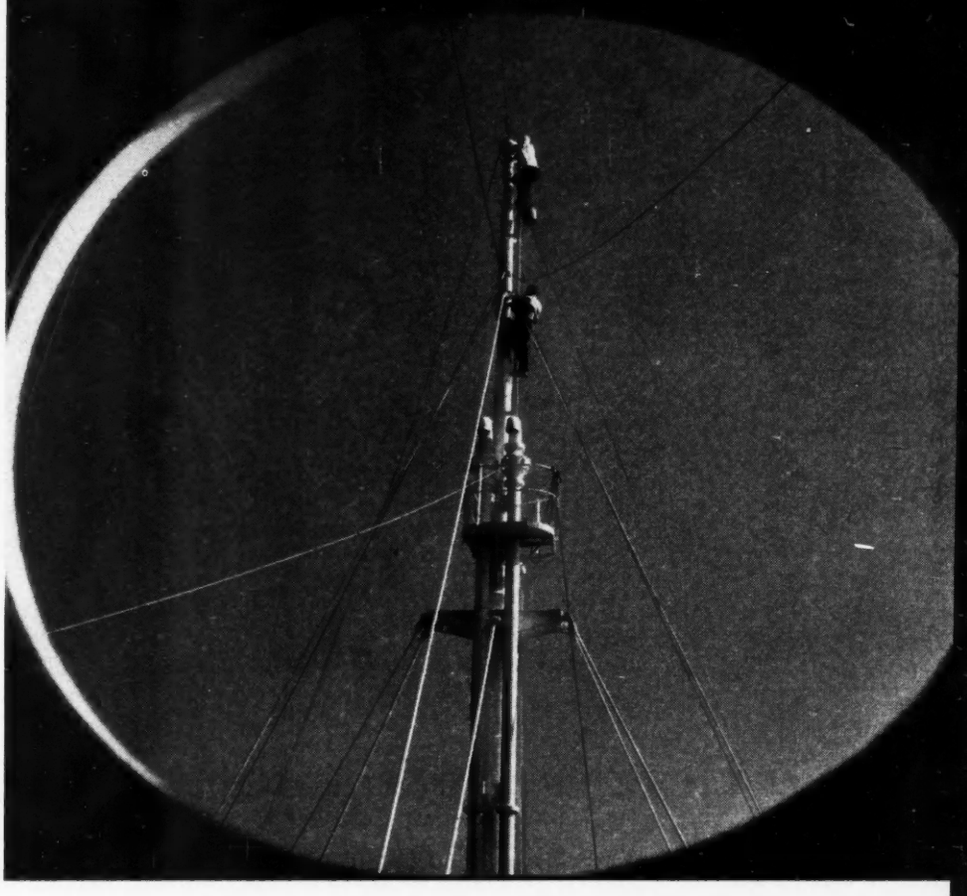
Seamen, not unlike sanitation crews in any city, are constantly at work doing the hundreds of menial chores which keep their huge craft clean as a yacht and smelling better than many which sail beneath private pennants.

Loading a tanker with several hundred barrels of petroleum products is a messy job but by noon of the first day "outside" the crew has slicked her up and is busy doing the maintenance work which will keep her that way.

Deck crews or "deck apes" as they are called by members of the "black gang," work a regular eight hour shift. These are the ordinary seamen. The first step progression-wise to "officers country" up forward. The bottom rung of the ladder leading to a master's ticket.

The bo'sun is the tanker's "pusher." A crew of 16 or 17 men work under his supervision on deck. The engine room comes under the bailiwick of the chief. The ABs are supervised by the mate.

Able-bodied seamen stand watch. They work four hours on and eight hours off. They relieve ten minutes to the hour and are called one half hour before time to stand their watch.



PORTHOLE VIEW of crewmen painting forward mast of tanker while at sea.

Up forward in the wheel house almost everything runs by buttons. The helmsman has been replaced by automatic steering, the navigator has been almost completely replaced by loran —an instrument which automatically guides the new tankers.

Latest safety devices insure the well-being of the men who ride their touchy load over miles of hazardous sea lanes. There is a button which can be pushed with one finger to stop every moving thing aboard and put out the boiler fires at the same time.

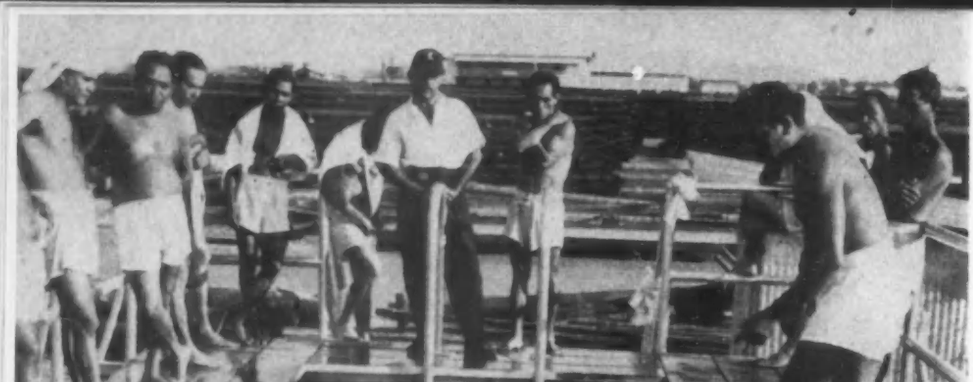
A tanker bristles with automatic, technical devices including one which sets off an alarm in case an order from the bridge to the engineer is disobeyed or misunderstood; and, down in the turbine room, another device controls boiler room steam pressure with just a touch of the finger.

Other safeguards include emergency escape panels; swinging chain ladders everywhere a man might have to climb out if steel steps should break; lifeboats readied for instant launching, supplies for every emergency, including rubber suits which can be donned by a man fully clad, even if he is wearing a life preserver. They cover him to his neck and are weighted to hold him right-side up in livable comfort in icy waters.

Gone is almost every semblance to the earlier tanker except the tank compartments to load liquids. Even these are dolled up with motors outside and pumps inside.

The newer, more modern ships demand the very latest in engineering and navigational schooling—added incentive for the younger generation to seek a salty career. Young men get ahead rapidly in the tanker service. There is, on record, the promotion of one man, just turned 21, to the rank of captain. He had to wait on more sea experience before being given an assignment as master of his own vessel, however.

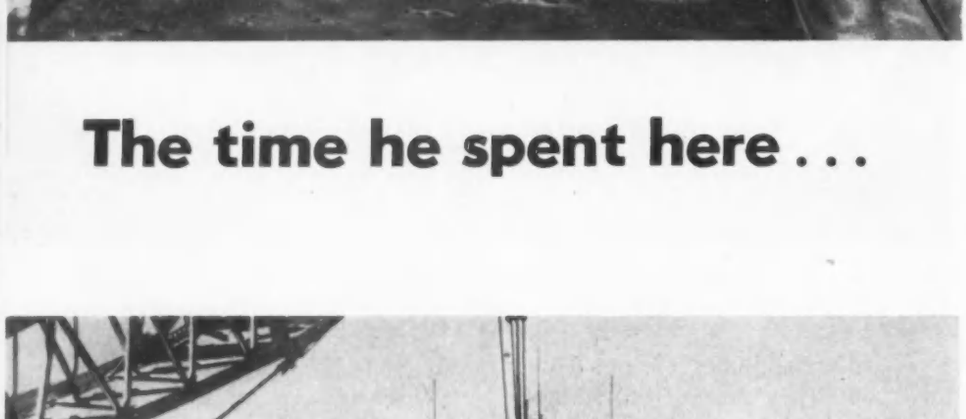
Many men become veterans in the tanker service because these crews are generally steady crews. Once a man has learned the advantages of tanker service he is not easily lured to other type vessels. —**The End**



SINK OR SWIM. A. Berbeci, Creole Petroleum Corporation drilling foreman (in tank at left), is shown receiving the training which a short time later enabled him to save his own life. Surrounding tank are members of a typical safety swimming class. Photo below shows Creole pipe-laying barge and flow station in Lake Maracaibo.

Creole employes take to the training tank for swimming lessons . . . a vital part of an offshore safety program.

The time he spent here . . .



. . . saved his life here

By CLIFFORD G. JANNEY,
Safety Administrator,
Creole Petroleum Corporation,
Caracas, Venezuela

On April 13, 1954, A. Berbeci, foreman on Creole Petroleum Corporation's drilling barge 2159, fell 18 feet into Lake Maracaibo, Venezuela, from the upper platform of well 815. Berbeci was fully-dressed in working clothes, including heavy safety boots and gloves.

The weight of his clothes pulled Berbeci deep beneath the water. But he swam to the surface and then 30 feet to the well. Raúl Linares, a fellow-workman, put his right leg into the water from the well's lower platform. Berbeci was able to steady himself with Linares' aid until he could grasp a safety-rope dangling from the well and pull himself from the lake.

Berbeci was able to save his life because he was a graduate of a Creole Petroleum Corporation swimming course. Before attending the course, Berbeci could not swim. If he had not had that training, he almost certainly would have drowned that April 13.

Berbeci was one of the first graduates of the swimming courses conducted by the Safety Section of the Creole Industrial Relations department for employes who work over water on Lake Maracaibo. He attended eight classes, of four hours

each, from February 9 until March 3, 1954. And little more than one month after he had completed the course, Berbeci was able to save his own life.

Operations in Creole's Western division are entirely over water on Lake Maracaibo. There are over 2000 over-water installations, including wells and flow stations, on which employes work. There are approximately 300 floating crafts such as launches, tugs and barges, covering a water work area of approximately 10 miles by 38 miles.

Lake Maracaibo offers a constant menace to workers. The accident type most common in Creole industrial fatalities over the past several years had been drowning. All of the usual preventive measures were taken, such as the placing of life preservers on launches, flow stations, drilling rigs, barges, etc., and the placement and hiring restriction that all men transferred to or hired for over-water operations must be able to swim.

Moreover, it was decided to swim-test all Creole workers then engaged in over-water operations. But Creole was in doubt as to the acceptance of such a program by the workers and, because of this, did not want to go into a large scale effort until effects of such a testing program could be determined.

Tia Juana was used as a pilot district. A tank 30 feet long, 8 feet wide and 5 feet deep was constructed into a swimming pool, incorporating all of the necessary health measures. Supervisors were tested first, then the workers, with good acceptance. After testing all 1400 over-water operations workers in Tia Juana District, it was found that approximately 10 percent could not swim. Meanwhile, La Salina and Lagunillas Districts had started testing programs.

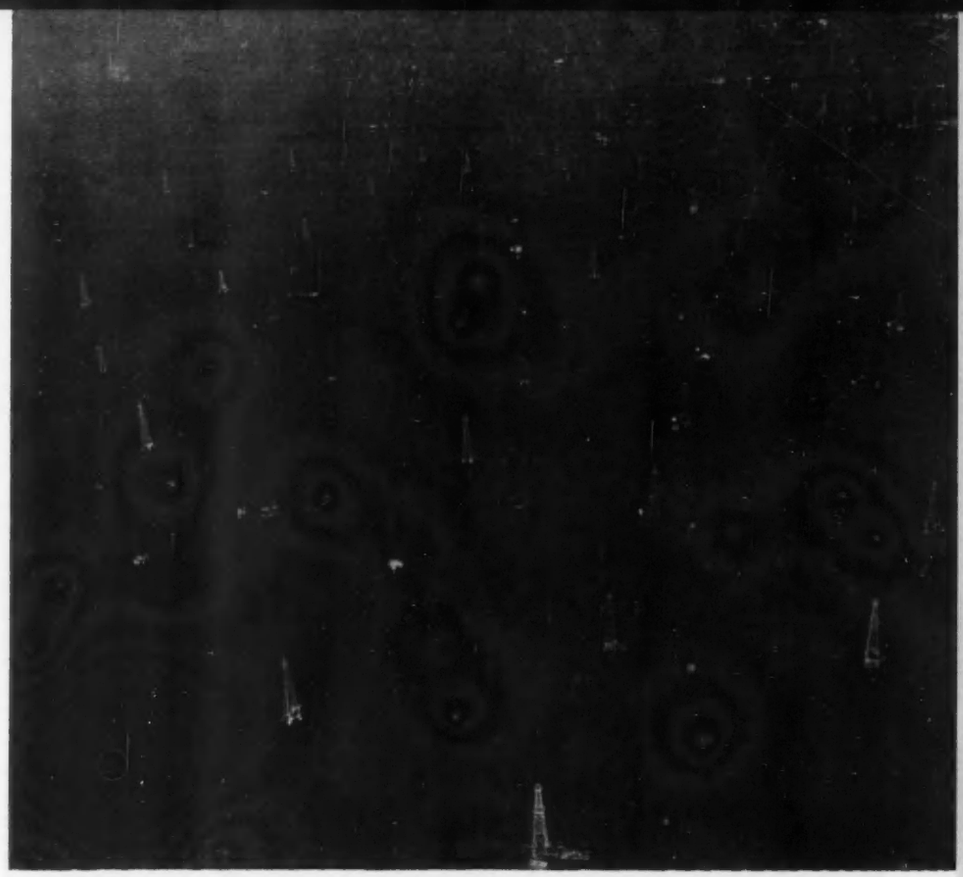
A physical education instructor was contracted by Tia Juana District to teach two divers how to serve as instructors.

Following completion of the tests, a Creole swimming-training program was started for all over-water workers who required instruction. The swimming classes are conducted on company time, four hours per day two days a week for four weeks. During the first two courses, 24 workers were taught to swim out of 28 who attended.

To assist a worker who falls into the lake, a steel cable has been stretched around the piles of the 97 over-water production flow station platforms, a few inches above the water line. The cable leads to a ladder by which a person may climb from the water to the platform.

Besides the immediate results of having every over-water worker able to swim, a by-product of the Creole swimming training program is becoming evident which in the long-range, accident-prevention program may overshadow the original intent of the swimming program: each worker graduating from the swimming training program is more appreciative of the efforts of Creole management to prevent accidents. This program is proving most effective in instilling safety-consciousness in Creole workers.

Management emphasis on the importance of safety, accepted by line organizations of their safety responsibilities, and a well-staffed safety organization available to assist have continued to produce steady annual improvement in Creole's safety record. The Creole accident frequency rate was 4.4 last year, lowest in company's history. —**The End**



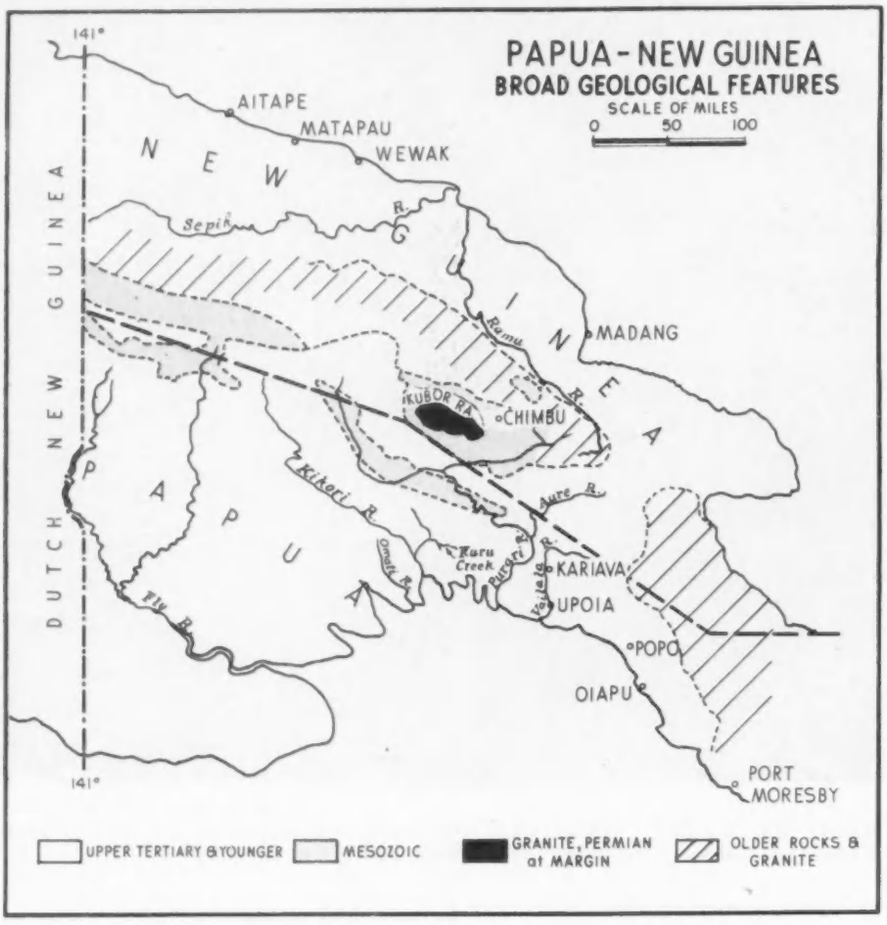
Creole Petroleum Corporation Photo

LAGUNILLAS FIELD, looking north. Wells in narrow strip offshore belong to Mene Grande Oil Company and those farther out in lake belong to Creole.

About the Author

CLIFFORD G. JANNEY graduated from Louisiana State University with a B.S. degree in electrical engineering in 1941, at which time he was employed by Westinghouse Electric and Manufacturing Company as a sales engineer.

During the war he was in an airdrome squadron located in the Pacific. In 1946 he was employed by Standard Oil Company (New Jersey) in the safety department of the Baton Rouge refinery. In 1949 he was transferred to Creole Petroleum Corporation as a district safety supervisor. In 1950 he was transferred to the Western Division supervisor's job; and in 1952 to the safety administrator's job at Caracas.



Hopes Are High as Papuan Exploration Moves Along

Wildcat Omati 2 reaches 7500 feet as seventh test on Kuru Creek is scheduled. Island Exploration and Australasian Petroleum Companies seek prospects in and above the Cretaceous.

By DON KLIEWER, WORLD OIL Staff

HOPES ARE RUNNING high that current exploration activity in the Australian Territory of Papua, the southern half of the eastern portion of New Guinea, will lead to oil discoveries. In fact, some Australian government authorities regard Papua's long-term prospects as superior to those of the Australian mainland.

Island Exploration Company Pty., Ltd., has worked consistently in the country west of the Aure Trough, where drilling has proved existence of at least 15,000 feet of Tertiary rocks, mainly of Miocene age. Omati 1 was begun in November, 1950, entered Cretaceous rocks at 10,065 feet, and encountered high pressure gas late in 1953 at 13,743 feet which stopped operations.

Before conclusive evidence on the significance of the show was obtained, a cave-in below the casing at 12,041 feet caused bit and drill pipe to stick. The hole was sidetracked in May, 1954, and had reached to within 815 feet of the high-pressure gas level when leaks developed in the 6⅝-inch casing. About mid-September, operations to seal the leaks were successful, and the sidetracked hole was being cleaned out preparatory to drilling ahead.

While interest in Omati 1 is high in Australia, greater hopes are attached to Omati, 2, which was spudded in on April 7, 1954, about two miles west of Omati 1. The second test reached 7500 feet during August, and ran into trouble. Difficulties occurred when 13⅜-inch casing was being inserted to 5600 feet. A joint collapsed at 4267 feet; however, the hole was opened and the collapsed casing removed, and operations are continuing. Before the casing collapsed, Omati 2 had been drilling 1400-1800 feet a week.

More than 20,000 square miles of Western Papua have been aerially photographed and mapped. In addition, 20 structures of interest have been examined. Field work has been supplemented by paleontological and petrological study of samples.

More than 22,000 square miles have been covered by magnetic, gravimetric and seismic surveys, and 35,000 square miles have been covered by airborne magnetometer traverses.

Transport by aircraft and helicopter has been used to minimize operational hazards in the heavily-jungled terrain. The companies currently employ 373 staff members and 2867 laborers, as well as many contracted experts in many fields.

By the end of 1954, the two companies operating in Papua will have spent a total of $25 million on the Papuan search for oil. Their future program provides for continued geological and geophysical investigations in Western Papua and additional drilling. Australasian Petroleum Company, Pty. Ltd. is the second principal operator.

Broad objective of the drilling program is to test structures which offer best prospects of containing good cover and reservoir conditions in and above the Cretaceous. It is considered highly probable that oil has moved into the Miocene limestone where it is in contact with Cretaceous rocks, and important accumulations are expected where there is cover above the limestone on a suitable structure. The view is also held that, provided the right lithological conditions are present, important accumulations may be expected in the Cretaceous rocks also.

Between 1912 and 1929 exploration sponsored by the Australian and British governments was centered princi-

pally around Popo. During that period, about $1 million was spent on the oil search.

Private companies took up the search between 1923 and 1939, concentrating their activities around the eastern side of the Gulf of Papua and the Oriomo Plateau. During that period, one of the principal operators was Papuan Oil Development Pty. Ltd., a subsidiary of Shell Company.

In 1936 Island Exploration and in 1938 Australasian Petroleum entered the field, and have remained the principal operators. Both are owned by The British Petroleum Company, Ltd., and Standard Vacuum Oil Company, although the Australian firm of Oil Search Ltd. owns a 10 percent interest.

Australasian Petroleum, until recently, has concentrated on the Aure Trough, where it drilled six dry holes without finding suitable reservoir conditions or anything better than minute oil traces. Deepest of these six was Kariava 1, which was drilled to 12,621 feet. The company now intends to test the country farther west, and a road is under construction to a seventh site on Kuru Creek. **—The End**

Extensive Cuba Drilling Program Is Announced

An agreement has been signed between Trans-Cuba Oil Company and the Cuban-Venezuelan Oil Voting Trust, committing Trans-Cuba to spend $3 Million in exploration and drilling on the 14,875,000 acres under concession rights of the 24 companies managed by the Cuban-Venezuelan Oil Voting Trust. In return, Trans-Cuba is to receive an undivided 50 percent working interest in the acreage.

Mediterranean Oil Co. Drilling Test in Sicily

Mediterranean Oil Company has begun drilling its first test well in Sicily, Comiso 1, on a 29,603-acre concession three miles northwest of the Ragusa field, where American International Fuel & Petroleum Company first found oil in commercial quantities in January, 1954.

Mediterranean Oil is jointly owned 65 percent by Gulf Oil Corporation's wholly-owned subsidiary, American International, and 35 percent by MacMillan Petroleum Corporation of Los Angeles, Calif.

What's Happening

AMONG WORLD OIL MEN

Nomads Honor Foreign Guests

W. Gray, left, and William Hodgkisin, center, of Le Grand Sutcliff & Gell, England, were visitors at a recent meeting of the Tulsa, Okla., chapter of NOMADS. Also in the photo are John Eckel, The Carter Oil Company, Tulsa, second from left; Bill Glass, Jr., Warner Lewis Company representative in Paris, France, fourth from left; and Warner Lewis, Warner Lewis Company, Tulsa.

HENRY E. LINAM, ex-president of Standard Oil of Venezuela (Standard Oil of New Jersey operations in Venezuela) from 1932 to 1943, has assumed direction of joint operations of Trans-Cuba Oil Company and Cuban-Venezuelan Oil Voting Trust.

Linam, born Oct. 3, 1899, began working in the oil fields at the age of 17 and was a driller at 19. He went to Venezuela in 1925 in the services of the Standard Oil. He became president of the Standard Oil of Venezuela in March, 1932, which office he held until January, 1943.

During Linam's presidency, the Standard's oil production rose from third to first place. He severed his connections with the Standard Oil in January, 1943, to return to the U. S. to enter the oil business as an independent operator.

Linam has been a trustee of the Cuban-Venezuelan Oil Voting Trust since its beginning in June, 1950.

H. E. SNOW, who was one of the three-man consortium delegation which negotiated the oil agreement with Iran, has resigned from the board of The British Petroleum Company, Ltd., on taking up the appointment of general manager of Iranian Oil Participants Limited.

Iranian Oil Participants Limited, incorporated in London where it has its headquarters, is the holding company for Iranian Oil Exploration and Producing Company and Iranian Oil Refining Company, the two companies formed to operate the Iranian oil industry under the recent agreement between the Iranian Government and eight oil companies.

Henry E. Winter

V. C. Georgescu

V. C. GEORGESCU has been appointed an assistant coordinator of the producing activities of Standard Oil Company (New Jersey) and HENRY E. WINTER has become regional executive for South American producing.

Georgescu, a naturalized American citizen, was long associated with the oil industry in his native Romania, serving with a Jersey Standard affiliate there before joining the parent organization at New York in 1947. Since then he has been assigned to the company's producing coordination staff, primarily dealing with Middle East and Far East operations.

Educated in England, Georgescu obtained his bachelor of science degree in petroleum engineering and refining at Birmingham University in 1926. Following oil field and petroleum equipment sales work in Romania, he joined Romano-Americana, a Jersey Standard affiliate headquartered at Bucharest, in 1937. Two years later he was appointed its managing director and in 1944 was elected president and chairman of the board. Romano-Americana was nationalized by Romania's communist government in 1948.

Winter, a native of Denver, Colo., obtained his B.S. degree in chemical engineering at the University of Nebraska in 1934. The following year he joined a Jersey Standard affiliate, Lago Oil & Transport Company, Ltd., in Aruba, N. W. I., as a student engineer.

From 1939 to 1954 Winter served with Jersey Standard affiliates in Venezuela, becoming manager of Creole Petroleum Corporation's Economics department in Caracas in 1948 and later manager of its western division at Maracaibo in 1953. He joined the Jersey Standard Producing Coordination staff last August.

Firefighters Go Fishing

Workmen are shielded by asbestos and aluminum shields while "fishing" for debris at Texaco Exploration Company's well which burned for 12 days in Alberta's Pigon Lake field during November. The fire was snuffed out by a dynamite blast set off by Myron Kinley, internationally known fire fighter, and assistants Asper (Boots) Hanson and Paul (Red) Adair.

a WORLD of OIL

By DON KLIEWER, World Oil Staff

British Somaliland: Standard-Vacuum Oil Company has acquired exploration permits covering 11,380 square miles through an assignment of rights that were held by Moriqui Exploration Company. Standard-Vacuum plans to expand geological activity started by Moriqui. Geologists now are undertaking an extensive surface study in the area to check the findings of a recent aerial survey.

Saudi Arabia: Arabian American Oil Company produced 317,315,016 barrels of crude during the first 11 months of 1954 for a daily average of 950,045 barrels, as compared with 281,638,345 barrels and 843,229 barrels for the like period of 1953.

Africa: Drilling of the first test well on Mafia Island, off the west coast of Tanganyika, East Africa, was scheduled to begin in December. The search for oil is being carried out by The British Petroleum Company, Ltd., (formerly Anglo-Iranian Oil Company, Ltd.) in association with the Royal Dutch-Shell Group. The drilling of this test follows intensive geological-geophysical surveys since 1951 over wide areas of East Africa.

India: Crude from Assam Oil Company's Nahorkatiya oil field in Assam, where four wells have been completed and a fifth awaits testing, has begun flowing through the 23-mile pipe line to the company's refinery at Digboi. A sixth well is scheduled to begin drilling . . . A contingent of geophysical operators from the U. S. has arrived with equipment in India to conduct surveys for Standard-Vacuum Oil Company on its concession north and east of Calcutta.

Sultanate of Muscat: Drilling equipment is enroute to Dhofar Province for a wildcat to be drilled on the concession held by Dhofar Cities Service, a subsidiary of Cities Service Oil Company and Richfield Oil Corporation.

Mexico: Total crude production for 1954 amounted to 85,064,000 barrels of which 23,690,000 barrels were exported, says Petroleos Mexicanos, the government oil monopoly. Current daily crude output is 265,000 barrels, up 37,000 barrels per day from January, 1954 . . . Five drilling rigs are operating now in the 1954 discovery field Miguel Hidalgo in Tecolutla, Veracruz, and three wells are producing.

Thailand: Nation's crude reserves are currently put at 22.7 million barrels

. . . Government has decided to employ a British firm to conduct a geophysical survey of the Chowphaya river valley. Area to be covered includes about 6000 square miles. In the meantime, an aerial survey of the entire area will be made.

Israel: Israel-American Oil Corporation's first deep test, on the edge of the Negev desert and 25 miles south of Beersheba, has been spudded-in. The well, Rekhme 1, is scheduled to be drilled to between 7500 feet and 8500 feet by Israel-American, a partnership company of Husky Oil Company and Bear, Stearns & Company, investment firm . . . Four other test wells are being drilled by three independent oil companies, three on the Mediterranean side of Israel and the fourth just west of the Dead Sea.

Germany: An oil-bearing horizon has been discovered in the Oligocene at 5020-5040 feet in the wildcat Heimertingen 3 of Deutsche Schachtbau-und-Tiefbohrgesellschaft mbH. situated north of Memmingen in Bavaria, with a test flow of seven barrels of light oil.

Tunisia: Prakla Gessellschaft fuer praktische Lagerstaettenforschung, Hanover, Germany, will conduct seismic surveys on concessions held by a French firm.

Czechoslovakia: Test drilling has proved the existence of oil in the area around Hodonin, near Groedig, in southern Moravia.

Hungary: Geologists have proved an extensive natural gas deposit at shallow depth between Csomad and Orszentmiklos, 20 miles from Budapest, the capital.

Poland: Oswiecim Chemical Combine reports a "drastic" boost in the manufacture of gasoline from coal.

Yugoslavia: Nation's oil objective in 1960 is approximately 5 million barrel annual production, as compared with an expected 1955 yield of 1.8 million barrels . . . Traces of crude have been found recently on the Dalmatian islands between Vrgorats, Metkovitch and Biokovo.

Canada: Husky-Northern-Target Savanna Creek 1 gas discovery southwest of Turner Valley, which flowed 8 to 10 Mmcf. on initial test flowed in excess of 10 Mmcf. on test of a Madison lime intermediate zone . . . A 491-barrel-a-day producer drilled by Stanolind Oil and Gas Company has extended Cardium sand production one and a half miles south and two miles west in the Pembina field of Alberta . . . The British American Oil Company Limited has brought in its first oil well at Pembina with a 40-barrel an hour well, and Texaco Exploration Company has brought in its initial Pembina success with a 22-barrel-an-hour producer.

Cuba: The Trans-Cuba Oil Company—Cuban-Venezuelan Oil Voting Trust joint well near the port of Jucaro, three miles north of the town and west of the Jucaro-Ciego de Avila railroad, is drilling ahead. The location is the southernmost point on land of the central sedimentary basin which was opened in May, 1954, by the Echevarria discovery near Jatibonico town . . . Echevarria 1, drilled by Kerr-McGee Oil Industries, Inc., with the Jarahueca Group, and the two offsets are producing a reported total of 700 barrels of low sulfur crude daily . . . Location for Echevarria 4 has reportedly been selected.

Communists Attack Own Petroleum Bureaucracy

The official Communist Party newspaper Pravda has charged that bureaucracy is rampant in the Russian Ministry of the Oil Industry.

"The central apparatus of the oil ministry is excessively inflated and divided into numerous superfluous subsections," a recent Pravda editorial said. "There are more than 500 different administrations, departments and sections in all, and one official for every two to three employes in the ministry. Solving of the most urgent problems is delayed by countless 'clearances.'

"Because of parallelism and confusion among the various departments and offices, suppliers have sent more than 300 million rubles ($75 million) worth of unwanted equipment to enterprises in the field. This equipment does not get used for years and deteriorates.

"Superfluous steps and duplication in guiding oil fields and enterprises are also common in the oil ministry's work. One can judge what an inflated apparatus costs the state by the situation in the Georgian Oil Trust.

"This trust has only three fields, but maintains 12 offices to serve them. There is one official for every four or five employes. Consequently, it is not surprising that administrative expenses alone for one ton of oil drilled by the trust's oil fields total 60 rubles ($15), while in other areas the full cost of drilling one ton of oil amounts to only 22 rubles ($5.50)."

Success Claimed for Sino-Soviet Oil Effort

The Sino-Soviet Petroleum Enterprise in China's Sinkiang province, which became 100 percent Chinese-owned with the transfer of Russian shares in the joint stock company to the Peiping government on January 1, 1955, has made "enormous" progress since it was established in 1950, according to Communist reports.

A dispatch from Peiping to the Russian press says the Sino-Soviet Petroleum Enterprise will produce 26 times as much crude oil in 1954 as in 1951, 51 times as much gasoline and diesel oil and 11 times as much kerosine. It adds:

"Specialists and equipment from the Soviet Union have turned the enterprise into a modern, efficient oil undertaking. Following completion of an automatic cracking plant in May, 1954, the price of gasoline fell by 56.7 percent as compared with 1951, the price of kerosine dropped 77.6 percent, and the price of diesel oil 77.9 percent."

Assam Oil Company's Well Is Failure

Assam Oil Company's Nahorkatiya 5, the latest deep well to be drilled in the recently-discovered oil area southwest of the main Digboi oil field in Assam, is a failure.

Drilled to a depth of 10,945 feet, the well penetrated all the sandstone rock layers proved productive in earlier wells in the area but failed to yield any sign of oil. In exhaustive tests, only waterbearing rocks were found.

All operations at the well have ceased and the drilling equipment will be removed as soon as the hole has been plugged.

The effect of this dry hole is that the extent of the oilbearing area to the south of the original discovery well is much less than was exected.

Well 5 is the first failure at Nahorkatiya. Well 6, to the northwest of Wells 1 and 2, was scheduled to start drilling in December.

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BURKBURNETT ROAD — WICHITA FALLS, TEXAS

CHILEAN ENGINEERS Armand V. Uribe (left) and Arturo P. Valasquez (center) discuss equipment with Robert K. Hoague of Weatherford Oil Tool Company, Inc.

Increased Activity Expected in Chile

Increased drilling and exploration activity is expected in Chile this year as the Chilean government tries to step up its 1954 average daily yield of 6000 barrels to meet its current refining capacity of 18,000 barrels a day. The difference is being made up principally with Venezuela crude. In the opinion of two recent Houston visitors from Chile—graduate engineers Armand V. Uribe and Arturo P. Valasquez, who attended the American Association of Oilwell Drilling Contractors drilling technology school at Odessa, Texas, exploration areas will be at Antefagasta, Atacama and Chiloe, in the extreme southern part.

Drilling programs are planned for Manantiales, Sombrero and Spring Hill, where there are already 130 oil and gas wells. Average bottom hole pressure in those wells is about 2000 pounds per square inch. With 28 rigs on contract, Santa Fe Drilling Company will continue its operation in the immediate future.

Prior to their reutrn to Chile, Uribe and Valasquez visited in Houston was Robert K. Hoague, Weatherford Oil Tool Company, Inc., who was one of their instructors at the Odessa school in cementing practices.

Reds Admit Azerbaijan Oil Yield Is Unchanged

Russia has admitted that oil output in established producing areas of Azerbaijan (other than the offshore

Caspian fields) has shown no increase during the past three years and that exploratory drilling has had unsatisfactory results.

Continuing a series of sharp attacks on Azerbaijan oil industry administrators, the Communist party newspaper Pravda declared:

"Azerbaijan has many untouched reserves and many unsolved problems in the technology and organization of well drilling. As a result the increased volume of drilling operations is not bringing a corresponding increase in oil output. Extensive drilling work has been carried on in developed areas of Azerbaijan during recent years, but oil output has remained at the 1951 level.

"Management of the former Azerbaijan Oil Federation took advantage of poor supervision by the USSR Ministry of the Oil Industry and was guilty of extravagance in using state funds. Exploratory work was frequently carried out in unpromising areas, was widely dispersed, and did not bring positive results. Consequently, no large oil deposits have recently been discovered in Azerbaijan on dry land.

"The USSR Ministry of the Oil Industry's Geology Administration and the former Azerbaijan Oil Federation's geological service often formulated plans for exploratory work without proper geological evaluation of previous results and without detailed discussion of such results by engineers, geologists and research institution personnel. Purpose was lacking in organizing exploratory work, and resources and funds were wasted.

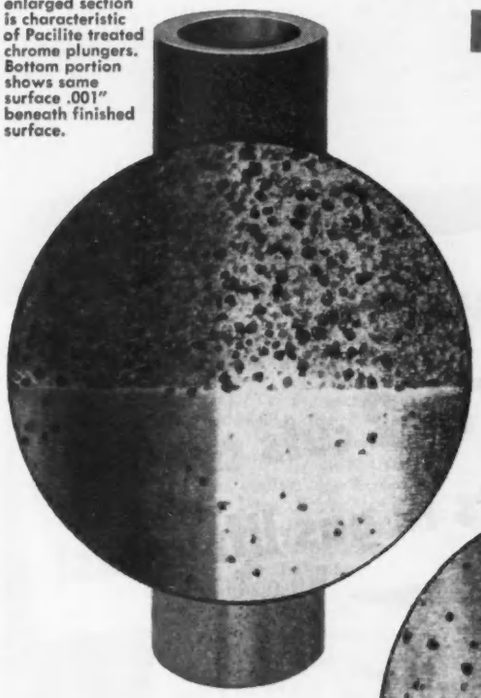
"The USSR Ministry of the Oil Industry sent a special commission to Baku late in 1953 to make a critical evaluation of the results of previous exploratory work and to make recommendations for future work. But no visible changes in the direction of exploratory work resulted."

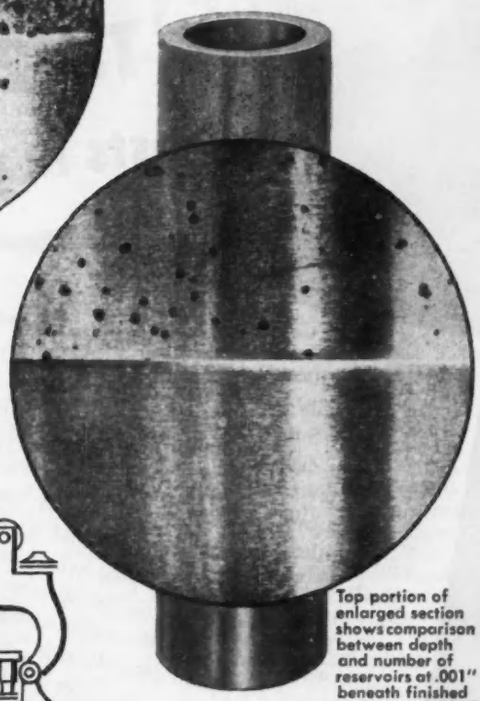
Pravda said the recently-formed Azerbaijan Ministry of the Oil Industry has been ordered to combat all manifestations of waste and to take advantage of all opportunities for reducing the cost of oil production. It added that fund allocations for drilling work are being reduced in 1955, but the present level of oil production is to be maintained.

The New Pacific

PACILITE (TRADE MARK) PLUNGERS FOR DEEP OIL WELL PUMPING...

The number of surface reservoirs on top portion of enlarged section is characteristic of Pacilite treated chrome plungers. Bottom portion shows same surface .001" beneath finished surface.





Top portion of enlarged section shows comparison between depth and number of reservoirs at .001" beneath finished surface and .005" where controlled etching has eliminated reservoirs.

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Mexico Continues Oil Resources Development

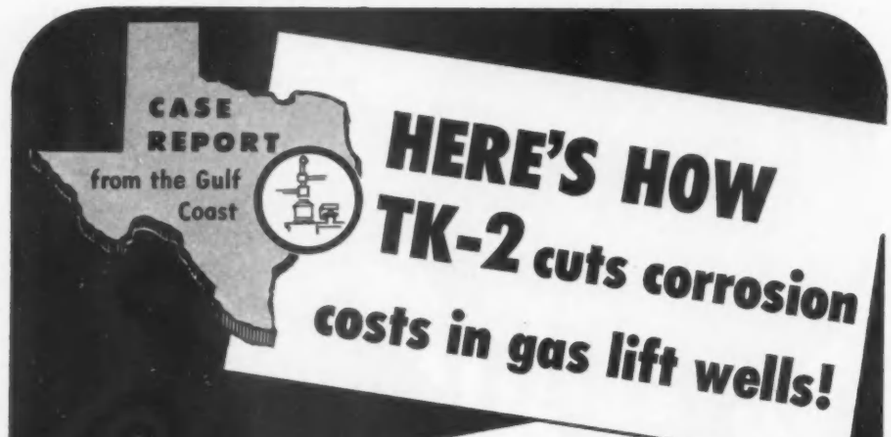
Despite a general slackening in the tempo of production, Mexico is going ahead with a program of development of oil resources. New areas opened up for exploration include the states of Coahuila, Nuevo Leon and Tabasco.

Pemex has recently filed four requests with the Secretary of Economy for the assignment of territories. These include:

- In Coahuila, a location in the municipality of Sabinas.

- In Nuevo Leon, the estates of Santa Monica and Dr. Coss, in the municipalities of Aldama and China, respectively, and the estate of Zacate, in the municipality of Dr. Coss.

- In Tabasco, the estate Cantemoc, in the municipalities of Jonuta and Centla. This region of Tabasco is distinct from that of Macuzpana, where wells are already in operation.



HERE'S HOW TK-2 cuts corrosion costs in gas lift wells!

In an oil field near Houston a major company had operated gas lift wells for seventeen years with little concern for corrosion. Suddenly, two strings parted which resulted in expensive fishing operations. Tests indicated a corrosive high water content was present. A caliper survey on the tubing showed that most of it was damaged beyond use, and all the tubing in all the wells had to be pulled. As much as 90% of the tubing had to be replaced. At this time, two full strings of pipe which had been coated with Tube-Kote's TK-2 plastic lining were installed. The other wells were replaced with uncoated pipe. The uncoated pipe perforated in approximately one year. The TK-2 coated pipe was inspected after one year and found to be in like-new condition. As a result of such excellent service, pipe coated with TK-2 is always used when work-over becomes necessary.

Up to now, TK-2 coated pipe has been in service in this field for three years or more and has showed no evidence of corrosion damage. This is another performance record that proves the value of using Tube-Kote lined pipe.

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Shell Will Re-Enter Australian Oil Search

The Shell Company, which spent $2 million in a search for oil in Queensland just after the last World War, has announced its re-entry to the exploration field, concentrating this time in Western Australia.

In the new venture, Shell will go into partnership with three of Australia's largest mining companies which have between them assets exceeding $60 million.

Shell will control 75 percent of the operating company, with North Broken Hill Ltd. holding 7½ percent, Broken Hill South Ltd., 7½ percent, and the Western Mining Corporation Ltd., 10 percent.

The return of the Shell interests to exploration means that every major oil company operating on a refining and distributing basis in Australia is now also engaged in the search for local supplies of crude.

Already well advanced in their exploration activities are The British Petroleum Company, Ltd. (formerly Anglo-Iranian Oil Company, Ltd.), California-Texas Oil Company, and Standard Vacuum Oil Company which, in addition to Shell, are operating or have under construction sufficient refining capacity to meet the whole of Australia's annual requirements.

Biggest problem facing the Shell interests is their lack of a search permit covering a suitable area. The company's announcement, however, that it and its partners were prepared to spend large sums on geological and geophysical work and, if necessary, on drilling, was timed to coincide with the fact that permits already in force in Western Australia come up for revision in October.

The most promising areas of Australia are contained in the 325,000 square miles now held by the Caltex-Ampol Company, West Australian Petroleum Pty. Ltd. The area is held under 20 separate permits and in order to hold them all WAPET must carry out genuine investigations in each. If it decides that it has its hands full with its drilling program in the Carnarvon Basin around Exmouth Gulf and in the Fitzroy Basin inland from Derby, WAPET may be prepared to give up some of its huge area, allowing Shell to gain a foothold in Western Australia.

What's Happening

AMONG MEN IN THE INDUSTRY

Kewanee Oil Company has announced the promotion of **J. M. Harbison** from assistant production superintendent to production superintendent succeeding **W. O. Albert**, who retired in December. Harbison joined Kewanee Oil Company as district engineer at Maljamar, N. M., in 1941. After military service he returned to Kewanee as district engineer in the West Pampa repressuring project. He was promoted to division engineer and assistant superintendent in charge of repressuring and development operations in the Panhandle division; promoted to division superintendent in 1950; and transferred and promoted to assistant production superintendent in the Tulsa office in 1952.

•

Evans Production Corporation, Atlantic Building, Dallas, has opened a district office in the Fair Petroleum Building, Tyler, Texas. The district manager in charge of the new office will be William L. Craig. Prior to joining Evans, Craig was for four year associated with DeGolyer and MacNaughton. For ten years before joining DeGolyer and MacNaughton, with the exception of four years' military service, Craig was with the Arkansas Louisiana Gas Company and served as assistant chief petroleum engineer. **James W. Mays** will serve the new office as district landman. He is a graduate of the University of Texas Law School. Mays was employed by the California Company in Mississippi and Alabama and also engaged in the lease brokering business prior to joining Evans Production Corporation in April, 1954.

•

Lloyd J. Taylor, former manager of the Land department for Floyd L. Karsten, has been appointed manager of the Houston office of **Midstates Oil Corporation.** Prior to his association with Karsten, Taylor was for several years district landman for The Ohio Oil Company in Houston.

•

John O. Rundle has been elected vice president—operations of **Loffland Brothers Company.** Rundle, who is presently vice president—operations of Loffland Brothers Company of Venezuela and Loffland Brothers Company of Peru, succeeds **B. B. Smith,** deceased. Rundle will continue in charge of all foreign subsidiaries including Loffland Brothers Company of Canada, in addition to assuming his added duties with the parent company.

•

J. P. Edwards, executive secretary of **Tide Water Associated Oil Company,** has retired after completing nearly four decades of service with the company. Edwards began his career with Pacific Mail Steamship Company in Japan. He was appointed assistant secretary of Associated Oil Company in San Francisco in 1916 and became corporate secretary in 1929. He also served as assistant to the president of Tide Water Associated and has been executive secretary of the latter firm since 1936.

H. W. Penterman

R. L. Trott

H. W. Penterman, executive assistant to the Tulsa area vice president of **Shell Oil Company,** will assume the new position of executive assistant to the vice president in Denver. Succeeding Penterman in Tulsa will be **R. L. Trott** of New York, land assistant in the company's head office Exploration and production department. Penterman first joined the company in 1919 as a roustabout and later became a scout clerk in the Land department. He transferred to Tulsa and later was appointed land superintendent in Houston. Prior to assuming his present job in 1948, Penterman served as land manager in the Tulsa office. Trott first joined Shell in the Land department in Dallas in 1927. Subsequently he served as chief title clerk in Houston, as district land agent in Tyler, Texas, and as land manager in Houston. In 1951 he was made land assistant in the company's New York head office and held that position until his recent promotion and transfer to Tulsa.

•

Shell Oil Company, Rocky Mountain division, has announced the following personnel changes: **Gordon Van Fossen,** junior exploitation engineer, Technical Services division, to exploitation engineer, Production department, Casper division; **Irvin Kranzler,** junior geologist, Technical Services division, to Casper division; **Roger A. Hauck,** junior geologist, Technical Services division, to Casper division; **Daniel Bakker,** junior geologist, Technical Services division, to Denver division; **Gordon Olsen,** analyst, personnel and industrial relations department, Pacific Coast area, to benefits supervisor, Personnel and Industrial Relations department, Denver area; **William Gibson,** geologist, Exploration department, Denver area, to Denver division; **John Bloomingdale,** to district geologist, Exploration department, Billings division; **Edward Washburn,** to district geologist, Exploration department, Denver division.

•

M. E. Schwarz, vice president and manager of the Mid-Continent division of **Seaboard Oil Company,** has been placd in charge of all of Seaboard's field operations and appointed assistant to the executive vice president in Dallas. **J. W. Rawley,** assistant manager of the Mid-Continent division, has been elected a vice president and manager of the Mid-Continent division with headquarters in Dallas. **H. B. Rainbolt,** assistant manager of the Mid-Continent division's Land department, has been promoted to manager; and **E. H. Watkins,** supervisor, has been made assistant manager of the Land department. **J. M. Clayton,** coordinator of the Geological and Geophysical departments in the Mid-Continent division, will assume this title for all company operations. **H. H. Lawson,** manager of the Land department in the Western division will become assistant to the vice president and manager of the Western division with headquarters in Denver. **J. F. McClung,** district landman at Midland, will be transferred to the Western division, Denver, as manager of the Land department. **H. M. Head,** district landman at Ardmore will be transferred to Midland as district landman. **R. M. Bischoff,** administrative assistant to the executive vice president in Dallas, is being transferred to the Western division at Denver to be assistant manager of production. **E. R. Smith,** district production superintendent of the California district, Los Angeles, is being transferred to the Mid-Continent division, Dallas, as reservoir engineer. **J. N. Conley,** regional geologist in the Abilene district, is being transferred to Denver as chief geologist of the Western division.

•

Helmerich & Payne, Inc., has announced the appointment of **James R. Gregath** as a drilling engineer. Formerly he worked as engineering trainee and development engineer for Richfield Oil Company in Long Beach, Calf. In 1948, Gregath joined Kuwait Oil Company, Ltd., in Kuwait as reservoir engineer, petroleum engineer and was later promoted to drilling engineer. More recently, Gregath was drilling engineer with Gulf Oil Corporation until his present appointment.

•

Allen Howard, formerly Auditing department manager for **Shell Oil Company,** has been appointed assistant controller. **David I. Meriney,** formerly assistant Auditing department manager, was named to succeed Howard. Meriney has been succeeded by **James E. Peck,** formerly treasury manager for the firm's Midland, Texas, production area office. Howard, who succeeds **A. A. Buzzi,** recently named controller, joined Shell 17 years ago as auditor for the division office. He rose to assistant Auditing department manager in 1946 and became manager in 1948. Meriney joined Shell in 1929 as an Accounting department clerk. He became assistant treasury manager in 1944 and was transferred to the head office in New York in 1949 as assistant manager of the Auditing department. Peck has been with the firm since 1935. In 1947 he became chief accountant for the Midland area and was named treasury manager in 1952.

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Henry L. Phillips, chairman of the board of **Sinclair Oil & Gas Company**, crude oil producing subsidiary of **Sinclair Oil Corporation** and vice president of the parent company, has retired from active executive duties. Phillips will continue as a director of Sinclair Oil Corporation, a position he has held since 1942, and as a director of the producing subsidiary. In his 38 years with Sinclair, Phillips has held many executive posts. He joined the company in 1916 and was made president of Sinclair Crude Oil Purchasing Company in 1921. Elected president of Sinclair Oil & Gas Company in 1930, Phillips directed the company's exploration and producing operations. He moved to the New York office, continued as head of domestic production and became chairman of the board of Venezuelan Petroleum Company. He also headed all Sinclair pipe line operations and was one of the founders and first president of the Platte Pipe Line Company in which Sinclair has a part interest.

Henry L. Phillips

•

Mid-Continent Petroleum Corporation has announced the appointment of two new staff members of the Research and Development department. **V. L. Brant** was named supervisor in charge of engineering succeeding **Harold S. Wood,** who reseigned to enter private business. **E. C. Mitchell** has been named supervisor of the economics section of the department.

•

Archie D. Gray has been elected associate general counsel of **Gulf Oil Corporation** and **Russell G. Connolly** has been elected secretary. Gray has been associate general attorney for Gulf and various of its subsidiary companies since 1947. Connolly has been a member of the company's Law department since 1948.

•

Paul Wolff, formerly chief marine engineer of **Kerr-McGee Oil Industries, Inc.,** has been named chief engineer of the company. Wolff, who joined Kermac as manager of the Kermac Marine department in 1952, will move to Oklahoma City to assume his new duties. The promotion establishes a new position with Kermac, as part of a continuing program of organizational changes.

•

Shell Oil Company's Tulsa division has announced the following personnel changes in the Production department: **Edon A. Davenport**, production manager in the Illinois division, becomes manager of Billings, Mont., production and is succeeded at Centralia by **M. H. Guess,** now district superintendent at Elk City; **W. M. Ashley, Jr.,** exploitation engineer, moved from Midland, Texas, to Tulsa; **R. P. Burns, Jr.,** geologist, technical services division, from Houston to Tulsa; **R. L. Essary, Jr.,** exploitation engineer, from New Orleans to Tulsa; **H. D. Grant, Jr.,** mechanical engineer, from New Orleans to Tulsa; **C. R. Kemp, Jr.,** mechanical engineer, from Houston to Tulsa; and **R. F. Marler, Jr.,** junior mechanical engineer, from Houston to Tulsa.

•

William Fleming and **A. W. Tarkington**, Fort Worth oil men, have been elected directors of the Fort Worth National Bank's board of directors. Fleming is managing partner of the **Fleming Oil Company** and is associated with Kay Kimbell in the firm of Fleming and Kimbell. Tarkington, vice president of **Continental Oil Company,** is regional general manager of the company's southwestern region with headquarters in Fort Worth. Formerly he was with First National Bank of Dallas, was assistant treasurer of Bethlehem Supply Company, and then treasurer of Conoco at Ponca City, Okla. He served as assistant to the president of Conoco, becoming vice president in 1951 and regional general manager of the central region before promotion to his present position in Fort Worth in 1953.

William Fleming

A. W. Tarkington

•

Union Oil Company has announced changes in the Production department. **K. C. Vaughan**, manager of field operations, Pacific Coast division, is appointed manager of the Natural Gas and Gasoline department; **W. O. Butler,** superintendent of the Coast division at Santa Maria, will replace **Vaughan; J. L. Stair,** superintendent of the Coalinga division, replaces Butler, and **H. T. Finney,** drilling superintendent of the Southern division, replaces Stair.

•

Southern Production Company, Inc. of Fort Worth has announced the appointment of **Dick T. Fenwick** as vice president. Fenwick has been manager of the company's Production and Operations department and will continue to head the department in his new position. An employe of Southern Production since its organization in 1941, Fenwick previously held positions as production and drilling engineer, superintendent, chief engineer, and manager of the Natural Gasoline and Processing departments. He succeeded **Roy C. Williamson,** now president of Southern Production, as manager of the Production and Operations department last January.

•

Frank C. Osment has been named assistant chief geologist—programs for **Stanolind Oil and Gas Company.** Osment, who will be located in Tulsa at Stanolind's general office, moves to Tulsa from Houston, where he has been division geologist in the company's Texas-Louisiana Gulf Coast division for the past 3½ years. Osment joined Stanolind in 1945. He served as a geologist in the Shreveport, La. office, becoming district geologist at Shreveport in February, 1949. In April, 1951 he moved to Houston as division geologist. **L. C. Ritts, Jr.** will succeed Osment as division geologist in Houston. Ritts has been serving as district exploration superintendent at Lake Charles, La. The position of district exploration superintendent at Lake Charles will be assumed by **L. C. Adams,** who has been district geophysicist at New Orleans. **J. T. McMaster,** formerly staff geophysicist at Denver, will become district geophysicist at New Orleans succeeding Adams.

DEATHS

A. M. (Ted) Meeks, 81, retired independent oil operator, died at Bakersfield, Calif. A native of Ohio, Meeks worked for The Ohio Oil Company in his early career. He operated in the Mid-Continent area out of Tulsa from 1911 to 1939.

•

Floyd Maddox, independent Dallas oil operator and former motor transportation official, died December 16 in Dallas. Maddox served as secretary of the Illinois Highway Users conference and the American Petroleum Industries conference before coming to Texas in 1941.

•

William C. Frye, 77, director of Chain Belt Company and former president of the firm, died November 16. He had been associated with Chain Belt for 60 years.

•

George C. Sproule, 74, retired oilman, died December 16. He had been associated with Kern Oil Company since 1921 and retired as its superintendent in 1945.

•

William W. Vosper, 79, founder of The Toledo Pipe Threading Machine Company, died December 17.

•

H. H. Watson, 63, independent oil operator and a director and vice president of the first National Bank of Midland, Texas, died December 14. He was field superintendent for Landreth Corporation at Breckenridge and elsewhere in West Texas for a number of years and was a pioneer drilling contractor in the Panhandle and the Permian Basin Empire.

•

Dr. William M. Burton, 89, retired president of Standard Oil Company (Indiana), died December 29 at Miami, Fla. With his associates, Burton developed the first commercially successful cracking process to make more gasoline out of crude oil.

•

James E. Skane, 63, executive of Manhattan Rubber Division of Raybestos-Manhattan, Passaic, N. J., died December 15.

•

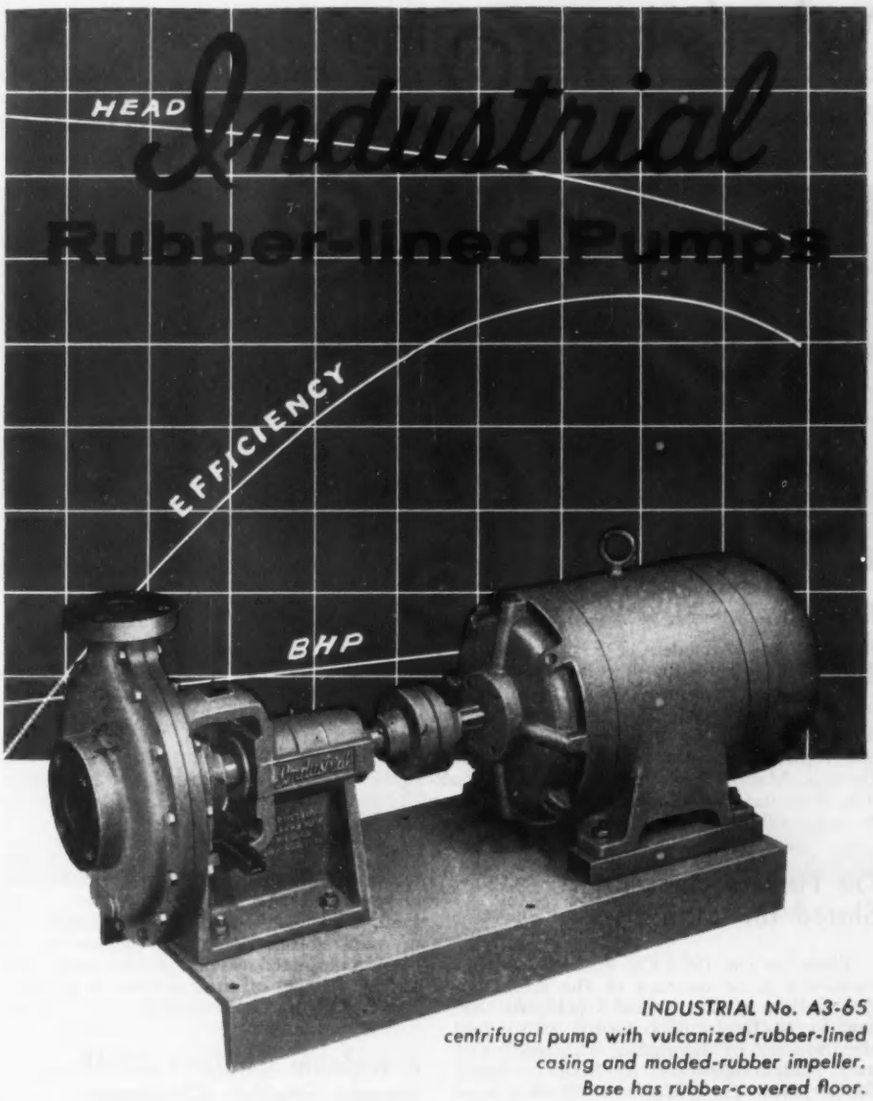
George G. Harrington, 56, vice president and chief engineer of Hunt Tool Company, died December 30 in Houston. Prior to joining Hunt Tool in 1943 as vice president and chief engineer, Harrington worked for Reed Roller Bit Company for 19 years. He was instrumental in developing many oil field tools.

•

Jack R. Herley, Southern California oil producer, drilling contractor, and equipment man, died December 23 in Rochester, Minn. He was owner of the Herley Pipe and Supply Company, Jack Herley Operations, partner in Herley-Kelley Oil operations, president of the Western States Drilling Company, Wilmington Oil Development Company, and vice president of the International Drilling Company, all of Long Beach.

•

L. H. (Harry) Angove, 86, Tulsa oil man and retired district superintendent in Tulsa for Sinclair Oil and Gas Company, died January 5. He had been affiliated with the old Prairie Pipe Line Company, which later became Sinclair, at Oil City, Penn.



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What's Happening

AMONG INDUSTRY ASSOCIATIONS

Planning for New Year

Permian Basin Crude Oil Representatives Association, with headquarters in Midland, Texas, makes plans for the year's program. Left to right are W. T. Shirey, Sinclair Crude Oil Company, treasurer; W. D. (Bill) Kleine, Phillips Petroleum Company, vice president; Guy M. Willis, Pan American Production Company, president; John A. Mills, The Texas Company, secretary-editor; Glenn L. Shoemaker, Stanolind Oil Purchasing Company, director in the National Oil Scouts and Landmen's Association, and Robert L. Denton, Magnolia Petroleum Company, alternate director in the national association. The Permian Basin association is made up of 28 members who represent 15 purchasers of crude oil.

Desk and Derrick Installs Officers in San Francisco

Newly-elected officers of the Desk and Derrick Club of San Francisco were installed recently with Marnie Douglas, Tide Water Associated Oil Company, serving as president for 1955.

Marnie Douglas

Others are Barbara Sage, Honolulu Oil Corporation, first vice president; Pat Clark, Union Oil Company of California, second vice president; Marie Doyle, American Bitumuls & Asphalt Company, corresponding secretary; Jacqueline Aldrich, American Independent Oil Company, recording secretary; Dorothy Basting, Reserve Oil & Gas Company, treasurer; Leone Zander, Shell Chemical Corporation, director for a two-year term.

Officers whose terms are held over include Mary Emrick, Standard Oil Company of California, junior past president and director; and Lee Gallatin, General Petroleum Corporation, director for one-year term.

Oil Finders Convention Slated for March

Plans for the 1955 Oil Finders Convention—the joint meeting of the American Association of Petroleum Geologists, the Society of Exploration Geophysicists and the Society of Economic Paleontologists and Mineralogists—to be held in Hotel Statler, New York, March 28-31 have been announced.

The habitat of oil, or the relationship of oil occurrence to the depositional basin will be the general theme of the technical program. This will be developed by a variety of papers. The SEG and SEPM programs will include papers and symposia relevant to the main theme. Papers of general interest will be presented in joint sessions to avoid time conflict with contributions of more specialized appeal.

Space has been reserved for commercial and educational exhibits. The former will display the latest equipment and techniques used in exploration for oil. The latter will feature geological maps, logs, cross sections, typifying activities of scientific professional societies, geological surveys, college and university departments, and similar non-commercial organizations.

The Pittsburgh Geological Society has arranged a two-day pre-convention field trip across the Appalachians from Pittsburgh to New York. In crossing the Allegheny Plateau, the Valley and Ridge province, the Reading Prong of the New England Upland, and the Triassic Lowland, the group will study strata ranging from pre-Cambrian through Triassic, including an almost complete Paleozoic section. A guided tour through the Lamont Geological Observatory of Columbia University is planned, as well as excursions to Bell Telephone Laboratories at Murray Hill, N. J.; and Esso Research Laboratory, Elizabeth, N. J.

The student employment interview service, initiated at the 1954 convention, will be provided. An interview center in the Penn Top South of the Hotel Statler will be open March 28-31 and the service has been announced to prospective employers and to colleges offering courses in geology, geophysics and paleontology.

Petroleum Chapter AIME Names Stanier Chairman

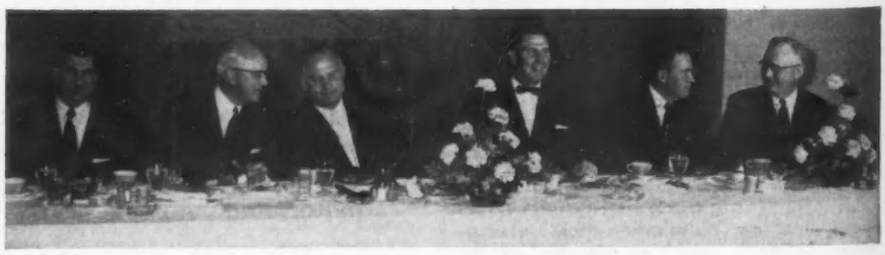
Newly elected officers for the Pacific Petroleum Chapter AIME have been announced. H. M. Stanier, Sunray Oil Corporation, is chairman and council members are Sam Patterson, Bankline Oil Company, and Milan G. Arthur, Union Oil Company.

The chapter also voted to petition the AIME board of directors for permission to assume section status. At present, the chapter is part of the Southern California section, which includes the mining and metals groups.

Oil Accountants Society Organizes Job Service

The Tri-State Petroleum Accountants Society, organized in the Illinois Basin about ten years ago, has inaugurated a new program, a non-profit enterprise for employment in the field of accounting for the petroleum and mineral industries.

This committee will furnish the operator with suggested names of accountants who fulfill his individual requirements and bring the accountant into contact with the operator requiring his skills. The service is rendered without charge to accountant or operator. Inquiries should be sent to Albert L. Potts, chairman, 23 Main Street, Evansville, Ind.



Houston NOMADS Honor Past Presidents

The Houston Chapter of NOMADS entertained 300 members and guests December 13 at a dinner honoring past presidents of the organization. Governor Dan Thornton of Colorado was guest speaker. Seated at the head table, left to right, Mike Halbouty, independent oil operator; George Strake, independent oil operator; Governor Thornton; R. K. Franklin, Rolo Manufacturing Company, and president of the Houston Chapter; W. W. Flenniken, president of Rocky Mountain Oil & Gas Association; and Rex G. Hamaker, president of Reed Roller Bit Company.

What's Happening

AMONG SERVICE AND SUPPLY MEN

J. L. Trittipi

J. K. Crane

V. W. Grotlisch

Melton W. Power

Carla Hildebrand

R. W. Kearney

E. L. Mohr, Jr.

R. G. Branch

Seymour Lester Brown

H. L. Richardson, Jr.

Frank A. Dunigin, Jr.

J. E. Oster

Dowell Incorporated has transferred three field engineers to the company's general office field development group in Tulsa. Serving as development engineers will be **J. L. Trittipo**, formerly station manager at Belle, W. Va.; **J. K. Crane**, formerly district engineer at Salem, Ill.; and **V. W. Grotlisch**, formerly sales engineer at Chicago Heights, Ill.

Melton W. Power has been promoted to assistant district manager of the Pauls Valley, Okla., district of **Welex Jet Services.** Power has been with Welex for more than four years. Starting as a rigger in the company's field service operations, he rose to shooter, senior shooter and sales engineer to his present capacity.

McCullough Tool Company has announced the appointment of **Miss Carla Hildebrand** as assistant personnel manager at the general offices in Los Angeles. She will work under **Harry Hester**, personnel and export manager, in supervising and integrating personnel matters for McCullough.

Tex-Tube, Inc., has announced the appointment of **R. W. Kearney** as assistant manager of sales. Kearney joined Tex-Tube two years ago after 10 years of experience in oil production specialty sales and oil company employment.

E. L. Mohr, Jr., has been appointed manager, Pacific Coast division of **Baroid Division, National Lead Company.** Mohr succeeds **W. L. Heater**, who is appointed assistant to the manager of the Drilling Mud department. Since joining Baroid in 1941, Mohr has served as service engineer, district superintendent, general superintendent of Pacific Coast division; and assistant manager of Pacific Coast division.

Oil Center Tool Company has announced the appointment of **R. G. (Bob) Branch** as sales representative in the Corpus Christi area. He was in the Sales department at Cameron Iron Works for seven years and at Heep Oil Corporation for 15 years before joining Oil Center Tool.

Seymour Lester Brown has been named district representative of **U. S. Steel's Oil Well Supply Division.** Brown joined "Oilwell" in 1937 at the Mount Pleasant store.

H. L. Richardson, Jr., has been appointed credit manager for the **Baroid Division, National Lead Company.** Before joining Baroid, Richardson was employed by Schlumberger Well Surveying Corporation as assistant credit manager.

Frank A. Dunigan, Jr., has been appointed division manager of the West Texas and New Mexico division of **Weatherford Oil Tool Company.** Formerly in charge of public relations, Dunigan replaces Todd Antrim, who resigned to enter private business.

J. E. Oster has been appointed plant manager, D & B Division, **Emsco Manufacturing Company**, Garland, Texas. Oster has been office manager of D & B division since 1946. He succeeds **J. G. Hast**, who died in October. Prior to employment with Emsco, Oster was with Standard Brands, Inc., Dallas, for 10 years. **J. W. Mackey** has been appointed office manager to succeed Oster.

The Continental Supply Company has named **J. A. McCreery** as manager of its store in Liberal, Kansas. McCreery replaces **W. A. Pratt**, who moved to McCreery's former position as field salesman at Liberal. **W. O. Morrow**, former warehouseman at Harvey, La., has been named Continental store manager at Eunice, La.

Paul I. Birchard has been appointed vice president and general manager of **Westinghouse Air Brake Company's** Le Roi Division in Milwaukee, Wis. Birchard replaces **Edward J. Green**, who has been temporary general manager of the Le Roi division since the resignation of **T. O. Liebscher**, former president of the Le Roi Company. Green will return to Westinghouse Air Brake headquarters in Pittsburgh to resume his position as executive assistant to the president.

Dana T. Hughes has been appointed director of information of **American Locomotive Company.** Hughes has been acting head of the company's news bureau since November, 1953.

Brakesol, Inc., has announced the transfer of **Buford Cranford**, sales engineer, to the Rocky Mountain territory with headquarters in Casper, Wyo. Cranford was formerly headquartered at Fort Morgan, and prior to that time, had worked in the Oklahoma territory for several years.

Tom E. Bryant

Harold E. Kaley

William H. Long, Jr.

Leon R. Cousland

John D. Cleary

Cordell Garner

Weldon L. Porter

P. J. Millar

Warren L. Sallee

M. W. Brooks

George C. Thomas

Cecil Laws

Iverson Supply Company has announced the promotion of **Tom E. Bryant**, field salesman at Farmington, N. M., to store manager at Kermit, Texas. **Harold E. Kaley** has been transferred from Price, Utah, to Midland in city and field sales. **William H. Long, Jr.**, who has been associated with major supply companies in the mountain states, has been employed by Iverson as city salesman of tubular goods at Oklahoma City.

Leon R. Cousland now represents **Orbit Valve Company** in Kansas and the Texas Panhandle. His headquarters will be at Liberal, Kansas. Before joining Orbit, Cousland had been with Bethlehem for nine years and most recently was field representative in Colorado.

John D. Cleary has been appointed operations divisions administrative assistant of **The Western Company.** Cleary served as chief industrial engineer with Armstrong Tire and Rubber Company at the Natchez, Miss., plant and the Carborundum Company at the Niagara Falls, N. Y., plant. Before assuming his new position with Western, Cleary was chief industrial engineer with Modine Manufacturing Company of Racine, Wis.

Cordell Garner has been named sales manager of the new Tubular division of **Plastic Applicators, Inc.**, of Houston. Formerly sales manager for Tube-Kote, Inc., Garner has been engaged in the development and application of plastic coated tubular goods since 1948.

Weldon L. Porter has been appointed a special representative for **Welex Jet Services, Inc.** Porter will work in Dallas from the Welex sales office in that city. Porter comes to Welex from Hunt Oil Company in Dallas where he has worked since 1951.

P. J. (Pete) Millar, Dowell Incorporated, has been promoted and transferred to the company's general offices in Tulsa. At the same time **Warren L. Sallee** has been promoted to district engineer and transferred from Tulsa to New Orleans. Millar joined Dowell in 1948 as a service engineer and served subsequently as station manager, sales engineer, area sales engineer and district sales engineer. Sallee joined Dowell in 1949 and was promoted to service engineer in 1950. For the past two years he has been a sales engineer at the company's general office in Tulsa.

Cummins Engine Company, Inc., has announced the appointment of **M. W. Brooks** as regional manager, Mid-West district, Central Region, with headquarters in St. Louis, Mo. Brooks will serve as Cummins representative in the Kentucky, southern Illinois, Missouri, Iowa, northern Kansas, Nebraska and South Dakota areas.

George C. Thomas, formerly assistant district manager for **Welex Jet Services, Inc.**, at Ardmore, Okla., has been appointed manager of a new Welex office in Bartlesville, Okla. The new office will specialize in radioactivity well logging, jet perforating, permanent type completions, formation fracturing, as well as other Welex services.

Cecil Laws has been named district manager in Corpus Christi, Texas, for **Hunt Tool Company.** Since his graduation from Texas A & M College, Laws has been a junior petroleum engineer with Pan American Production Company; engineer representative for Bethlehem Supply Company, and district manager for Baash-Ross Tool Company.

John Herbert Ahrens has been promoted to assistant district engineer, machinery and equipment sales and service for **U. S. Steel's Oil Well Supply Division** at Casper, Wyo. Ahrens joined Oilwell in 1953 as a junior engineer. Earlier this year he was named field representative at Casper.

The Continental Supply Company has announced the appointment of **Herbert P. Dawkins** to credit manager of the Gulf Coast division with headquarters in Houston. Dawkins joined Continental at Longview, Texas, in 1948. He was moved to the Credit department in Houston and in 1952 was placed in charge of credits for the Arkansas, North Louisiana, Mississippi and East Texas Division in Shreveport. **John B. Barr** will replace Dawkins as division credit manager at Shreveport and **J. K. Glenn** was named district credit manager of the Rocky Mountain district in Casper, Wyo.

Charles W. Felker, senior engineer of **Baroid Division, National Lead Company**, at Lafayette, La., has been transferred to Houston as sales representative of the Gulf Coast division. In addition to his duties as sales representative at Baroid, Felker is pilot for the company airplane based in Houston.

Marion G. Johnson has joined **Maintenance Engineering Corporation**, Houston, as sales engineer in the metering and control equipment section. Johnson has had six years' experience as sales service engineer with Bailey Meter Company in the Houston branch office. Prior to his work with Bailey, he was with Aluminum Company of America in the New Kensington, Penn., plant.

George C. Childs has been appointed sales engineer for the Masoneilan and Smith Meter division of **Coastal Engineering Corporation**, New Orleans. Childs, a graduate of Louisiana State University, has been process engineer, project engineer and staff and instrument engineer for Firestone Tire and Rubber Company's synthetic rubber plant at Lake Charles, La., during the past six years. He will reside in New Orleans and his territory for Coastal Engineering will include all of southern Louisiana.

Ben Hilliard has joined the Sales department of **Web Wilson Oil Tools, Inc.** as division sales manager headquartering in

Charles D. Gammello

Roscoe O. Hambric

James A. Radney

Kenneth W. Massey

Los Angeles. Hilliard has been with Byron Jackson Company for the past 20 years, during which time he served in the Mid-Continent, New York Export and California areas.

•

Charles D. Gammello has been promoted to area merchandise manager for **U. S. Steel's Oil Well Supply** Division at Columbus. Gammello moves to his new Columbus headquarters from Charleston, W. Va., where he has been assistant to district merchandise manager since 1951.

•

The Continental Supply Company has announced the appointment of **Roscoe O. Hambric** as assistant division manager of the Kansas-Oklahoma division with headquarters in Tulsa. Since 1953 he had served as a district manager in Wichita, Kansas.

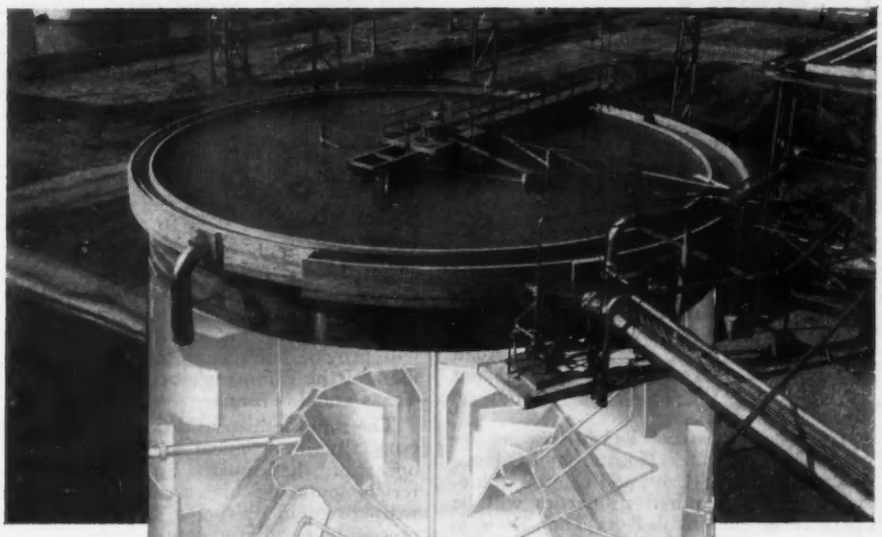
•

Cardinal Chemical, Inc., has promoted **James A. Radney**, former station manager, to the Odessa district as sales and development engineer. He is replaced as station manager by **Kenneth W. Massey**, former treating engineer.

•

T. Deal Reese and **George J. Trageser** have been named vice presidents of **Gulf Supply Company.** Reese becomes vice president and regional sales manager with headquarters at Houston. Trageser serves as vice president and merchandising manager with headquarters in Beaumont. Reese joined Gulf Supply in 1947 when he opened the firm's sales office in Houston. He was elected to the board of directors a year later and named Houston district sales manager in 1951. Trageser has been with the company since its organization in 1947, serving as merchandising manager and a member of the board of directors.

another Cochrane solids-contact reactor



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Reactors • Deaerators • Continuous Blow-Off • C-B Systems • Specialties

(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

Joy Manufacturing Acquires Assets of Baash-Ross

Joy Manufacturing Company of Pittsburgh, Penn., has acquired for cash substantially all of the physical assets of Baash-Ross Tool Company of Los Angeles, producers of an extensive line of oil and gas field equipment.

Current annual sales of the Baash-Ross firm are about $7 million per year. "This acquisition," J. D. A. Morrow, president of Joy, said, "is part of Joy's diversification and expansion program. It will enable the company to expand its activities substantially in the growing oil and gas field market. We are planning to increase the sales and service of the Baash-Ross business, particularly in Canada and abroad where Joy is well established for sales and service in all the important foreign oil producing fields."

The main plants of Baash-Ross are located at Los Angeles; Houston and Odessa, Texas; Oklahoma City; and Canton, Ohio.

The newly acquired properties will be operated as the Baash-Ross Tool Division of Joy Manufacturing Company. Glenn D. Johnson, presently executive vice president of Baash-Ross, will become a Joy vice president and general manager of the new division.

Baroid Mud Logging Service Upheld by Appeals Court

The U. S. Court of Appeals for the Fifth Circuit (Case No. 15035) has affirmed the decision of the U. S. District Court for the Southern District of Texas, which held patents invalid in the suit of Esme E. Rosaire vs. Baroid Sales Division, National Lead Company.

Rosaire alleged that the detection of gas in drill cuttings as done by Baroid as a part of its well logging service infringed his patents Nos. 2,192,525 and 2,324,085.

The District Court a year ago held the patents invalid and not infringed by Baroid, but having held the patents invalid the Appeals Court did not consider infringement.

Beryllium Corporation Opens Houston Office

The Beryllium Corporation of Reading, Penn., announces the opening of a sales office at 1915 South Shepherd, Houston, with Ross E. Schofield as district representative in charge. From this office Schofield will provide sales engineering services to users of the Company's beryllium alloys in Texas and Louisiana.

The rapid industrialization of the region, especially in chemical and petrochemical operations, has spurred an interest in materials featuring high strength combined with corrosion resistance. Beryllium alloys, especially beryllium copper, possess these and other properties desirable to the Texas-Louisiana trade. With the establishment of direct sales representation in Houston by The Beryllium Corporation, nearby service on an important group of materials is available to this market for the first time.

The new Houston office will in no way conflict with the present distribution of the company's beryllium copper safety tools used by the petroleum and chemical industries for their nonsparking properties. Safety tools will continue to be marketed through The Beryllium Corporation's established network of distributors in the area.

Dresser Industries, Inc. And Lane-Wells to Merge

Rodney S. Durkee, chairman of the board of Lane-Wells Company, announced that the board of directors of the company have voted to accept the offer of Dresser Industries, Inc. to exchange 576,000 shares of Dresser Industries common stock for all the assets of Lane-Wells Company, subject to that company's liabilities. In effect the stockholders of Lane-Wells company will receive four shares of Dresser Common Stock for each five shares of Lane-Wells stock presently held. A special meeting of the stockholders of Lane-Wells will be called in the near future to approve the action of the board of directors.

The Lane-Wells Company is a leading supplier of oil and gas field services and products. It operates through three divisions and two foreign subsidiaries and has over 100 branches throughout the oil fields of the U. S., Canada and Venezuela.

Well Surveys, Inc., a wholly-owned subsidiary of Lane-Wells, pioneered the development of radioactivity logging of oil wells and now licenses the right to use this service to other companies. In addition to a highly skilled Technical Engineering and Research department in the parent company, this research subsidiary is engaged in electronic research and the development of new instruments and tools for oil well logging.

Lane-Wells Opens Branch At Okmulgee, Okla.

Lane-Wells Company has opened a new branch in Okmulgee, Okla. The new branch is fully equipped to provide perforating service and well logging service on the usual 24-hour a day basis. It is under the direction of James Clark, veteran in oil field service.

Harold Lindsay and Delmar H. Dickerson, both experienced Lane-Wells personnel, come with Clark to staff the new branch. Quarters for the new office have been taken at 300 North Alabama Street.

S. R. Bowen Appoints New Mexico Representative

S. R. Bowen Company, announces the appointment of Stewart-Patterson Specialty Company, Farmington, N. M., as area agents for S. R. Bowen Company.

Besides a complete line of fishing tools, Stewart-Patterson carries a full stock of S. R. Bowen sealed type "I" rotary jars and safety joints in order to adequately care for the needs of fishing, testing and coring service companies.

OVER 100 GPH FOR EACH POUND OF PUMP

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The complete editorial index covering all issues of WORLD OIL published during 1954 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to *all subscribers* who write requesting copies. All you have to do is to refer to the Reader Service blue postcards (on Pages 225-226), fill in your name, company, position and address and add the words: "Send Index." Mail the postage prepaid card and the Index will be sent you.

Houston Distributor Named by Rayonier

Milwhite Mud Sales Company, Houston, has been appointed a distributor for Rayonier Incorporated's new product, Rayflo.

Rayflo is the new domestic dispersant for oil well drilling muds. Milwhite will distribute to all major drilling areas in the United States.

Cummins Sales & Service, Inc. Publication Wins Top Award

The Cummins Bulletin, sales publication of Cummins Sales & Service, Inc., has won a top award in the U.S. for promoting its company and products.

The McCormick-Armstrong award and plaque, top prize given by the Society of Associated Industrial Editors, was presented to Editor Victor LeMay at the group's recent convention in Salt Lake City, Utah. It was one of three honors won by the magazine. Others were for all-around editorial achievement.

Another magazine published by LeMay for Mid-Continent Supply Company, The Mid-Continent News, received S.A.I.E.'s award of merit, which LeMay also accepted at the convention. Jack Ripper is assistant editor of the two publications.

Hercules Motor Opens New Florida Branch

Hercules Motors Corporation has opened a new factory branch located at 400 South Edgewood Avenue, Jacksonville, Fla. The new branch will serve as a parts warehouse for Florida, Alabama, Georgia and South Carolina. Facilities of the new factory branch include a large salesroom, modern offices, parts department and repair shop.

Hercules gasoline, gas and diesel engines and power units will be available for immediate delivery. In addition, a large stock of service parts will be maintained.

The new branch is manned by factory trained personnel. John C. Poulton is branch manager.

Guiberson Completes New Rubber Plant

The Guiberson Corporation, Dallas, Texas has announced completion and occupancy of a new rubber plant addition which more than doubles the former working area. The original building was remodeled and integrated with the new addition to form a unitized plant. An air conditioned laboratory allows accurate checking of physical properties in the numerous natural rubber and synthetic rubber compounds developed by Guiberson for oil field use. The fully equipped laboratory facilitates a program of constant research and development, coupled with rigid quality control of regular production, carried on by Guiberson chemists who are specialists in compounding oil field rubber products.

Macco Corporation Appointed Distributor

The Drilling Fluid Division of the Macco Corporation has been appointed a distributor for Rayonier Incorporated's new product, Rayflo.

Rayflo is the name of the new, domestic dispersant for oil well drilling muds, introduced to the oil industry. Macco will distribute primarily to the California oil industry.

WORLD OIL'S Trading Post CLASSIFIED ADVERTISING

RATES: Regular Classified (undisplayed) **set in this size type: 12 cents per word. Minimum charge, $3.** Blind box address in our care counts six words. Replies forwarded without charge. **Situation wanted ads, 6 cents per word. Display ads,** set in suitably larger type with ruled border, $12 per column inch; situation wanted display ads, $6 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All classified ads payable in advance. COPY DEADLINE:** 17th of month preceding date of issue. Send copy and checks to: **Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.**

FOR SALE

GASOLINE PLANT FOR SALE

Gasoline Plant, located in Brazoria County, Texas, shut down in January, 1954. Had been processing approximately thirty-three million feet of gas daily with absorber pressure approximately six hundred thirty pounds. Plant recovered Propane, Butane, Gasoline, Kerosene and Diesel Oil. Adequate storage tanks for all products. Drum Lead Blending Plant. Detailed inventory available upon request.

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WE BUY, SELL, rent all kinds cable drilling and fishing tools. Largest selections. Send us list of needs. Save money. Thousands of feet of used tubing, casing for sale. New Surplus wire lines. **TRI STATE SUPPLY,** Box 827, Parkersburg, West Va., Phone 7-5121.

■ Failing 1500, truck-mounted drilling rig with 980 feet of 2⅞-inch drill pipe and tools. Also truck with water tanks, all in excellent condition ready to run. Price $12,500.00. Olson Bros. Drilling Co., By Andrew O. Olson, R#1, Arlington, Wash.

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■ Petroleum Engineer under 35, drilling and production work, Rocky Mountain area, with compact but enterprising operator, excellent financial structure. Salary dependent upon experience and qualifications. Send detailed experience record. Box 51-W, c/o WORLD OIL, Houston, Texas.

■ Petroleum Engineer with Master's Degree, or Doctor's in Chemical, Mechanical, or Petroleum Engineering, for research and teaching in Reservoir Mechanics and related fields at rapidly growing southwestern institution. Rank and salary open, twelve months employment possible, consulting work encouraged and available in immediate area. Applications will be kept confidential. Box 53-W, c/o WORLD OIL, Houston, Texas.

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Ideal for oil, water and gas systems, 850 to 900 psi.

Pipe located in Illinois, with low barge, rail and water rates to any part of the world.

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Cameron Iron Works Buys British Oil Field Company

Herbert Allen, vice president and general manager of Cameron Iron Works, Inc., Houston, has announced from London, England, the conclusion of negotiations for the purchase by Cameron of the entire capital stock of British Oil Field Equipment Company, Ltd., from Heenan & Froude and The Brush Group, British industrialists.

The BOFEC properties are located in England, with general sales offices in the Time & Life Building, New Bond Street, London, and the manufacturing plant in Leeds. BOFEC is a manufacturer and marketer of oil well drilling and producing equipment. In 1950 Cameron Iron Works entered into a License Agreement with this British firm under which a number of Cameron products, including blowout preventers, mud valves, well heads and christmas tree fittings were manufactured and sold to oil operators within the sterling area.

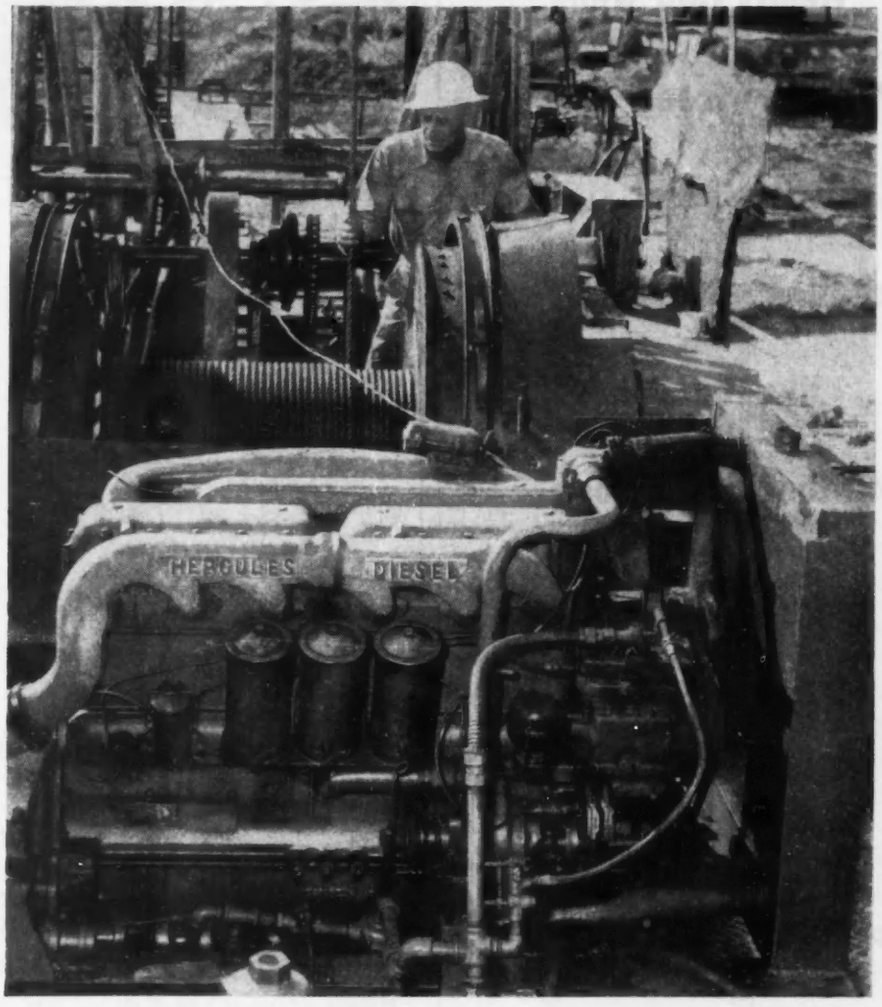
The company will continue to operate under the name of British Oil Field Equipment Company, Ltd. Edward M. Benjamin of London will continue as managing director of the newly acquired firm and some personnel from the Cameron organization in Houston have already been transferred to the English subsidiary company. The board of directors consists of J. S. Abercrombie, chairman, Herbert Allen, Ralph H. McCullough, and O. L. Lorehn, all of Houston, and Peter Marriage and Edward M. Benjamin of England.

Los Angeles Executives Form Metals Club

A group of California metal-working executives have formed a new club, the Quarter Century Metals Club. Membership is limited to men who have served in an executive capacity for at least 25 years with Los Angeles and Orange County firms engaged in the manufacturing or processing of metals. There are more than 120 members.

Directors include Delbert Axelson, retired, Axelson Manufacturing Company; William Batchelor, general manager, General Electric Company, Ontario; W. A. DeRidder, retired, General Metals Corporation; W. W. Farrar, vice president, Farbest Corporation; Robert Gregg, foundry manager, Reliance Regulator Division, American Meter Company; Jim Griffin, president, James H. Griffin Company; Earle V. Grover, president, Apex Steel Corporation, Ltd.; Ott Hammer, president, Security Engineering Division, Dresser Operations, Inc.; Earle M. Jorgensen, president, Earle M. Jorgensen Company; Lloyd D. Kay, president, Kay-Brunner Steel Products, Inc.; J. C. Meyer, general partner, Snyder Foundry Supply Company; K. T. Norris, president, Norris-Thermador Corporation; Morris B. Pendleton, president, Plomb Tool Company; John B. Rauen, chairman of the board, United States Spring & Bumper Company; Alden G. Roach, president, Columbia-Geneva Steel Division, U. S. Steel Corp.; Lionel J. Soracco, manager of sales, Bethlehem Pacific Coast Steel Corporation; J. D. Spalding, works manager, The National Supply Company; R. A. Stumm, president, Southern Pipe & Casing Company; Reese H. Taylor, president, Union Oil Company of California; and C. B. Tibbetts, president, L. A. Steel Casting Company.

Case History of Dependable Service



"No Shutdown in 2 Years!"

No Shutdown in 2 Years has been the "on-the-job" experience of the above Hercules Diesel Engine Model DFXE, operating for the K. B. Knox Drilling Company. Regardless of the work to be done in the oil field—if it requires power — it can be done with continuance and economy with high-speed, heavy-duty Hercules engines.

With over 70 models from 39 to 1468 cubic inch piston displacement and from 3 to 500 H.P., Hercules engines provide dependable power for operation on gas, gasoline, diesel fuel, L.P.G. or kerosene. Whatever your power requirements may be, Hercules has an engine to fulfill your particular needs.

In addition to this wide selection of engines Hercules Motors Corporation has a large network of service outlets. Hercules branches and distributors are located throughout the oil country to provide expert engine service. Hercules stores are located in Houston, Odessa and Kilgore, Texas; Jacksonville, Fla., Los Angeles, Oklahoma City and Salem, Illinois. You'll also find Hercules distributors in Tulsa, Shreveport, New Orleans, Dallas, Corpus Christi, El Paso, Lubbock, McAllen and Alice, Texas; Great Bend, Kansas and Edmonton, Canada.

Engine Manufacturing Specialists Since 1915

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(For more data on advertised products, use Readers' Service blue cards, last page this issue.)

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like hundreds
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from tubing
on each stroke of pump,
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Huber production oil field equipment also includes:

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prolong coupling
and barrel life,
distribute wear equally.

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new, no bolts to tighten.

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Henderson Welding and Warehouse
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Duncan, Oklahoma

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Odessa, Texas

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Northwest Industries, Ltd.
Edmonton, Alberta

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the Composite Catalog,
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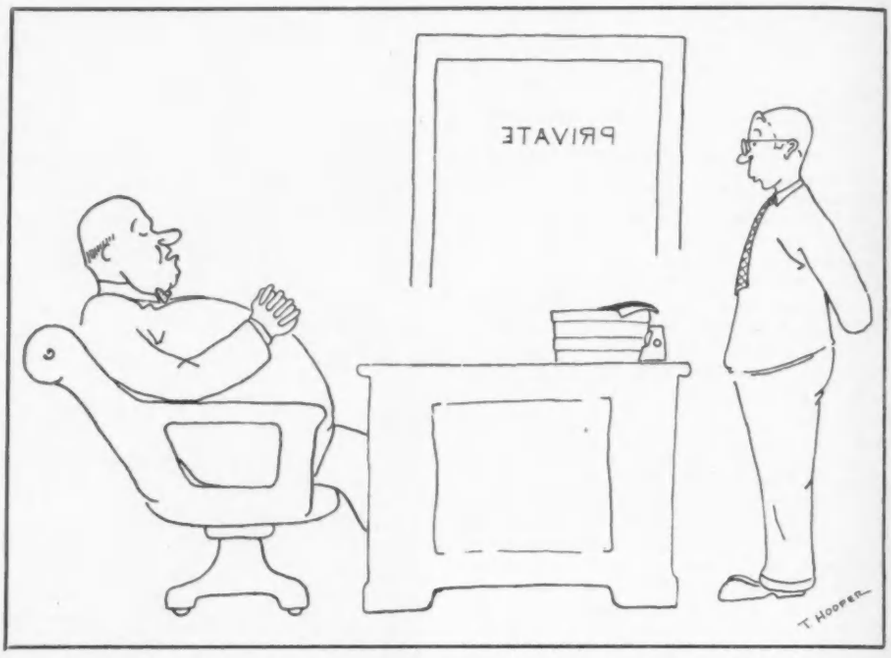
Borger, Texas

SQUEAKS from the BULLWHEEL



"I'd like to give you that raise, Smith, but our earnings were down last year to $39,467,338 from $39,726,421 in '53—so I'm sure you appreciate our problem."

Some Corn

Census taker: "How many bushels of corn did you raise last year?"

Hillbilly: "Didn't bushel it—we bottled it."

That Was No Lady

Hekimar was new in the store business. "Have you an account here, ma'am?" he asked.

"No," the lady replied, "but I would like to see the manager."

Hekimar led her into the manager's office and announced, "A no-account lady to see you, sir."

Don't Want Much

Stern Parent: Young man, can you support a family?

Young Man (meekly): I only want Sara.

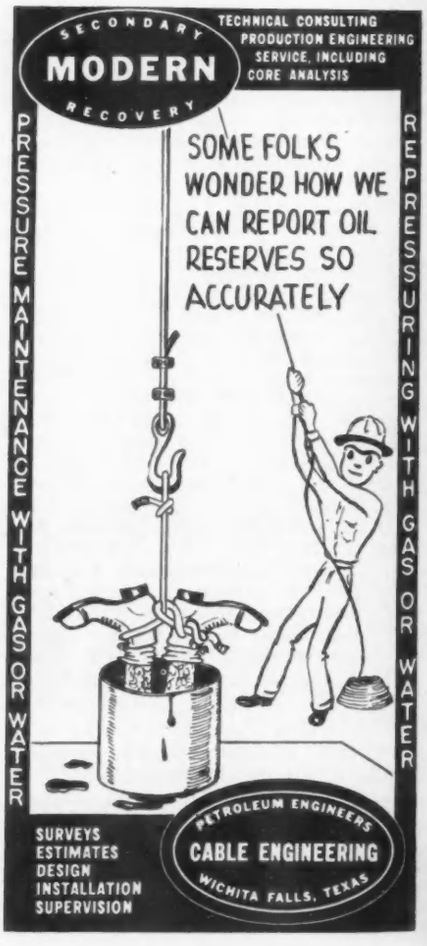
How Dangerous?

Patient: Will the operation be dangerous, Doctor?

Doctor: Now you don't worry about that. You can't buy a dangerous operation for only $50.

Honest Mistake

A little girl was sent to the drug store for something to stop palpitation. It was a long walk and she had a short memory and when she reached the store she said: "Mother said she wanted something to stop population."



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★ Larger range of sheave SIZES, 17"-20"-24". Less friction loss, roller bearing sheaves, roller thrust bearing block.

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McKISSICK PRODUCTS CORPORATION
Box 2496 Tulsa, Oklahoma

"The last company I worked for paid twice as much—right to the day they went broke."

Stop, Mon!

In the Alps, McAndrew hired a taxi at the station to get to his hotel. On the way the taxi skidded downhill and the driver yelled: "My brakes are gone. I can't stop the car!"

McAndrew, terribly excited, replied: "At any rate, mon, stop the meter!"

Story of Wealth

A story is told of a young man who called one evening on a rich old farmer to learn the farmer's story of how to become rich.

"It's a long story," said the old man, "and while I'm telling it, we might as well save the candle." And he blew it out.

"You needn't go on," said the youth. "I understand."

Examination

A lovely young thing had just been brought into the hospital for an operation. The doctor examined her and told her to undress and prepare for the ordeal. She did so and climbed on a wheel table, after which the nurse covered her with a sheet and left.

Presently, down the hall came a man clothed in white. He paused when he came to the girl, lifted the sheet, then dropped it and went on his way. Behind him came another white clad figure who did the same, and then a third who repeated the action.

"For heaven's sake," cried the nervous girl, "when are you going to operate?"

The third man in white cleared his throat and answered, "Damned if I know, lady, we're just the painters."

Source of Income

A minor-league baseball club had sold one of its prize rookies to a major-league team for a fancy price, and the rookie moved his small family to the big city. The first day in town his wife and little daughter went window shopping. The little girl spied a gorgeous doll that cost $25.

"Oh, Mother," she cried, "I wish I could have that!"

"But dear, it costs too much—we can't afford it."

"Why not?" she asked. "Couldn't we sell Daddy again?"

There's A Difference

A South Sea islander with a ring in her nose is a savage. But a New Yorker with a pearl screwed in her ear is civilized.

Obviously

The lecturer was trying to make a telling illustration: "If I brought a donkey a pail of water and a pail of beer, which would he drink?"

"The water," came a woman's voice from the front row.

"And why would he take the water?" asked the lecturer.

"Because he's a stupid ass," came a man's voice from the rear.

Just Off the Press!

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"K" Monel Collar Enables Accurate Control of Straight Hole or Directional Drilling

When you reach your target without deviation, you save substantially in rig time, labor and other expenses, which may only show up later.

You can make a *constant check* on deviation when you drill using a "K" Monel drill collar. For non-magnetic "K" Monel drill collars render it possible to make straight-hole tests *and* directional surveys at the same time . . . as often as you want. And without round-tripping pipe. That way you not only know whether you're keeping within property lines, but also, the exact direction of the well at every point. You have a complete record that you can refer to any time during the life of the well.

And, of course, for controlled directional drilling, a "K" Monel collar is practically essential.

When positioned in a "K" Monel collar, the survey instruments are not only free of magnetic effects from the drill string, but are also properly centered and aligned. And there are none of the hazards inherent in running instruments in open hole.

At all well temperatures, and regardless of cold-working, "K" Monel remains non-magnetic. Drilling contractors can lease "K" Monel collars from the Sperry-Sun Well Surveying Company at 3118 Blodgett Avenue, Houston 4, Texas.

Whatever your job, when you face an oil field metal problem, let Inco engineers help find the solution. From among the many Inco Nickel Alloys available, there is probably one that meets your needs, exactly. If not, they'll work with you to find the right answer.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Accurate Drilling is assured in both vertical and directional work without pulling the string, when survey instruments are lowered into a non-magnetic "K" Monel drill collar. By insisting on this method, you can avoid excessive equipment wear and other operational difficulties caused by crooked holes.
(Picture courtesy of Sperry-Sun Well Surveying Company, Houston, Texas.)

Inco Nickel Alloys

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"S"® Monel • Inconel® • Inconel "X"®
Inconel "W"® • Incoloy® • Nimonic® Alloys
Nickel • Low Carbon Nickel • Duranickel®

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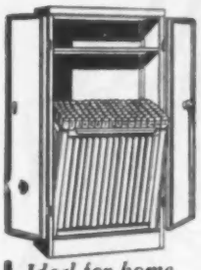

MAP FILE

MT4

Metal cabinet map file with locking doors. 112 tilting tubes. Easy to file and find maps, tracings to 60".

Ideal for home and field offices.

PATENT NO. 1610368 Other Patents Pending

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"I'm a failure. Every tax write-off well I drill ends up a discovery."

It's Hot In Here

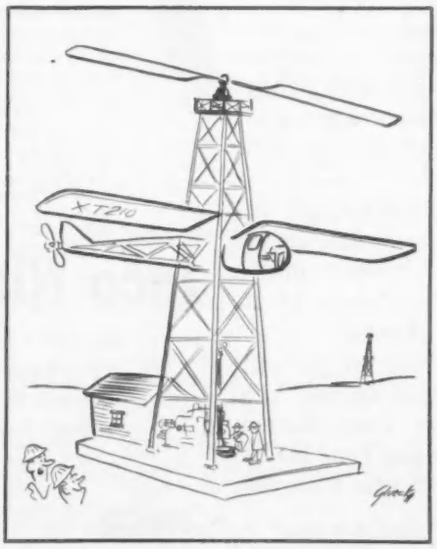
A New England pastor had been missing one of his regular parishioners. The man had been a steady attendant at Sunday services, but lately hadn't made an appearance. The minister decided to visit the man in his home.

He found him sitting before the open fire. Without saying a word, the minister took the tongs, lifted a glowing coal from the fire and laid it aside on the hearthstone. They both watched the sizzling coal in silence until the backslider exclaimed, "That's enough. I'll be there next Sunday!"

Too Much Trouble

Wide-eyed, the nine children of a mountaineer watched a salesman perform his morning ablutions. He washed, shaved, filed his nails, combed his hair, brushed his clothes . . .

"Gee, mister," exclaimed a leggy boy, "you sure are a lot of trouble to yourself, ain't you?"



"We're prepared to pull up and abandon the site on a moment's notice."

Author! Author!

"I wrote a confession story once."

"Did they publish it?"

"No, but the editor came all the way here to see me."

Detailed Instructions

The bachelor, left in charge of his baby nephew, faced a dilemma. Frantically he called a friend, a young father with his first hopeful, and was thus coached:

"First place the diaper in the position of a baseball diamond, with you at bat. Fold second base over home plate. Place nephew on pitcher's mound. Then pin first base and third base at home plate."

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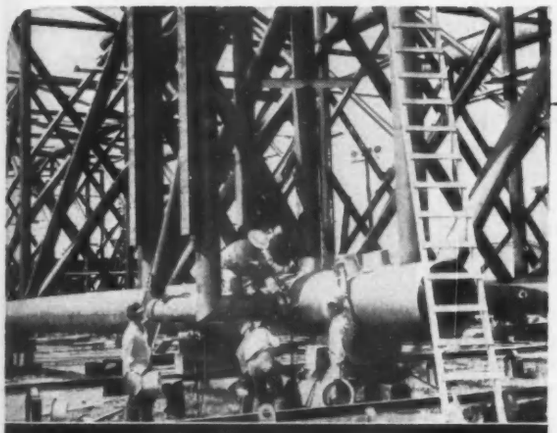

What with the ever increasing off-shore oil activity, the 4 divisions of Avondale become relatively more important as services to the Oil Industry! In truth, the 4 divisions comprise a team to serve the Oil Industry—every phase of it, from production to refining. Service Foundry Division—casting, gear cutting, machine work. Harvey "Quick Repair Plant"—drydocking, expert propeller service. Main Yard—steel fabricating, ship, barge, towboat building, and repairs. Avoncraft Division—Porcelain Enamel Service Stations.

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What's New in Equipment

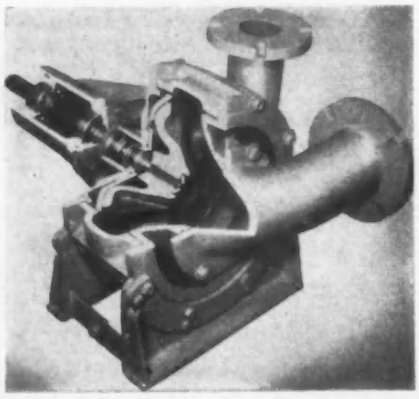
Drilling • Production • Exploration

Gasoline Engine

Kohler Model K160, a four-cycle, air-cooled, gasoline engine rated 6.6 horsepower at 3600 revolutions per minute, is now available with electric starting. Designated by Kohler Company as the K160s, this engine is equipped with a six-volt electric starter and generator, ignition switch and starter button.

The K160s carries a number of standard features including a silencer-type muffler, ball bearings, oil bathed fly-weight governor, oil bath air cleaner, fuel filter and a 1¼-gallon fuel tank. The specially designed air cooling system keeps the engine at correct temperatures under all operating conditions.

For more data circle **No. E1** on Readers' Service Card, last page this issue.



Solids Pump

Pumping of anything from live fish to ready-mixed concrete has proved possible in test installations of a new kind of pump introduced by Western Machinery Company. The first basic patent in many years on any centrifugal type pump has been issued to it.

The Wemco pump can pump ready mixed concrete without binding on large chunks or suffering wear at an excessive rate. It can pump waste material without clogging on rags, rope, string and rubber. This pump has oil field and refinery applications, such as drilling mud handling and sludge pumping.

The new Wemco torque-flow pump operates on a materials moving principle. Its impeller is similar to an automobile fluid drive, and though entirely out of the material flow pattern, it induces a vortex (swirl) that does the pumping. The rotating fluid mass forms a buffer between the impeller and the solid particles and chunks in the flow so that few of them ever touch. There is no clogging because the interior of the pump offers no restriction to flow. These advantages have been proved in many actual applications.

For more data circle **No. E2** on Readers' Service Card, last page this issue.

All-Purpose Welder

The Lincoln Electric Company has introduced a new universal, combination arc welder which provides a choice of either AC or DC welding current. The new machine, called the Idealarc, is said to provide an ideal type of welding arc for every type manual welding application, permitting selection of either AC or DC and either a soft or forceful arc.

For any welding job there is one type of arc which is best suited for that job. The job may best be done by either AC or DC and with either a soft type of arc or a digging forceful arc. The machine is available in several combinations. It can be obtained as an AC welder without the DC current. To this unit a DC package can be easily attached in about one hour whenever desired. It is also available as a combination AC and DC machine with selection of either current made through a simple twist of a switch handle. Different output capacities of DC and AC can be combined to fit the machine to the job requirements. The machine thus can be quickly set for maximum efficiency on every type of welding; ferrous or nonferrous materials, sheet metal or heavy plate, all positions, and under arc blow conditions or poor fit up.

For AC welding jobs the machine provides a single phase transformer type welder, the circuit of which has been designed to give greater arc stability than is normally associated with welding transformers. The machine is said to produce

an exceptionally smooth spray type of transfer of metal.

For DC welding, the Idealarc provides DC welding current through heavy duty rectifiers. Dual control of the arc is provided and, in addition, ability to select either normal or "hot" starting with the arc booster. Current models available are 300, 400 and 500 ampere AC combined with DC capacities in 200, 300, 375 and 450 amperes.

For more data circle **No. E3** on Readers' Service Card, last page this issue.

Geophysical Cables

Vector Manufacturing Company announces the development of a new series of rubber jacketed, nylon insulated geophysical cables. Developed for use in extreme hot or cold temperatures, the extruded jacket is compounded from 60 percent natural rubber to provide the long-life, toughness and dependability required in seismic application.

The cable is the only such product made exclusively for the geophysical industry.

For more data circle **No. E4** on Readers' Service Card, last page this issue.

Save time! Keep informed! Circle numbers on Readers' Service Cards, last page this issue.

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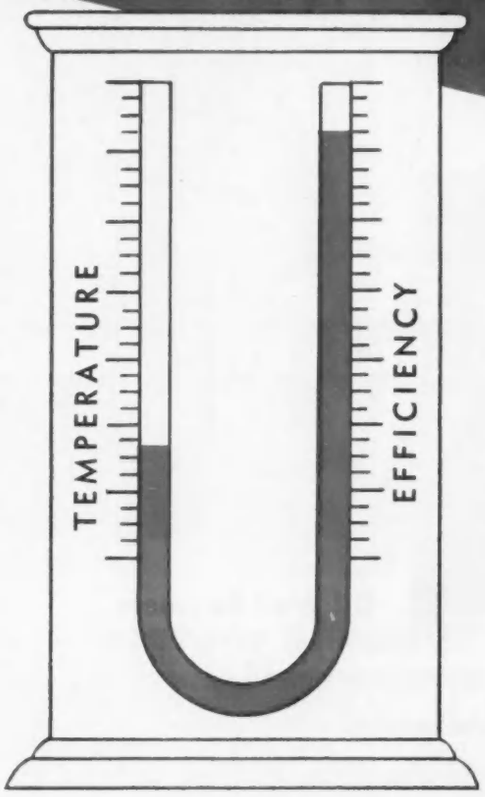
LONG STROKE UNIT
Runs COOL

LOW OPERATING TEMPERATURE MEANS HIGH EFFICIENCY!



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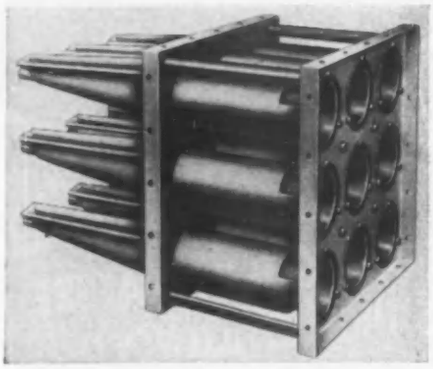


Dust Collector

An outside-in twist that reverses the normal tangential flow of most centrifugal dust collectors is credited with giving American Air Filter's new Amerclone dry granular dust collector efficiency over a wide range of air volumes.

The heart of the development of this collector is a conical inlet which imparts a swirling motion to dust particles, while permitting clean air to travel through the "Type G" Amerclone tube without changing direction. Each tube has an approach velocity of 1000 feet per minute and a cleaning capacity of 333 fpm.

Nine tubes are combined in a standard modular cell, which has a nominal rating of 3000 cfm with a face area only 20 inches by 20 inches. Any number of the modular cells may be combined to achieve required capacity within available space.

The basic Amerclone unit includes a secondary exhauster circuit which provides for disposal of the 10 percent of the primary air and collected dust bled off by the Amerclone tubes.

The manufacturer claims material space savings because each tube has two or three times the rated capacity of conventional collectors of comparable size. Built of thick wall gray iron castings with no recirculation of dust load, the Amerclone tubes are unusually resistant to abrasion. The standard Amerclone is limited to temperatures of 750° F. Special materials may be employed for higher temperature applications.

For more data circle **No. E5** on Readers' Service Card, last page this issue.

Mud Thinner

The first domestically produced dispersant or commonly called thinner for oil well drilling muds to serve as a complete replacement for dispersants now imported has been announced by Rayonier Incorporated. The new product, designated as Rayflo, is reported to be the answer to the search for a domestic product in adequate supply to replace quebracho extract.

Rayflo is particularly resistant to the adverse effects of contaminants such as cement, salt or calcium sulfate. This resistance to contamination should result in a more stable mud which would be more economical and efficient. Rayflo is readily soluble in water and does not require the use of caustic soda for dissolving, also less caustic soda is required to attain a given level of performance. Tests show that Rayflo-treated mud has lower viscosity and gel strength at low alkalinity than a quebracho-treated mud.

The new Rayonier product is a reddish brown powder described chemically as a polymeric polyphenol. Commonly used fluid loss reducing agents such as C.M.C. (sodium carboxymethyl cellulose), sodium polyacrylate and starch can be used effectively with Rayflo. It is also compatible with other commonly used deflocculants such as quebracho, calcium lignosulfonate and complex phosphates. Emulsions formed with the aid of surface active emulsifiers such as tall oil soap are effectively stabilized by Rayflo.

For more data circle **No. E6** on Readers' Service Card, last page this issue.

Trailer-Mounted Rig

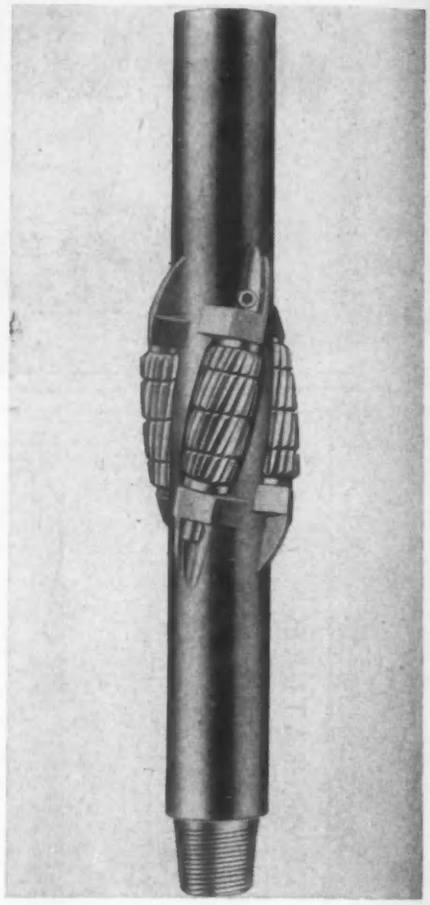
A new mobile trailer mounted rotary drilling rig incorporating the double trailer Lee C. Moore heavy-duty 91-foot mast set-up, where one trailer carries mast, substructure, walkway and rotary table, has been introduced by the Hose-Austin Drilling Corporation.

Twin Caterpillar D337 engines, rated at 450 horsepower intermittent, compounded with Alamo drive transfer power through an Emsco GB-250-T torque converter get a rating of 350,000 pounds with racking capacity of 7200-feet of 4¼-inch drill pipe.

Two additional Cat D337s, rated 320 horsepower continuous, power the independently driven 7¼-inch by 14-inch pump. This rig with auxiliaries is suitable for conventional rotary drilling in depth range 3000-feet to 7000-feet, well workover jobs to depths of 12,000-feet, and slim hole drilling to 10,000-feet and is so designed that it will load out in eight trucks, including two loads of drill pipe, and requires only about 45 hours of set-up time on location.

Auxiliaries offered include vapor proof lighting, manual or hydraulic blowout equipment, mud tanks, shale shaker, standby pump driven from driving works compound, and a Berry hydraulic drive system for driving shale shaker circulating pump and blowout equipment.

For more data circle **No. E7** on Readers' Service Card, last page this issue.



Oil Well Reamers

Grant Oil Tool Company is featuring a line of drilling tools designed to handle the entire range of reaming operations. Cutter assemblies are simple to replace, but cannot be removed accidentally. They are available for any model in three different types that suit a wide diversity of subsurface conditions.

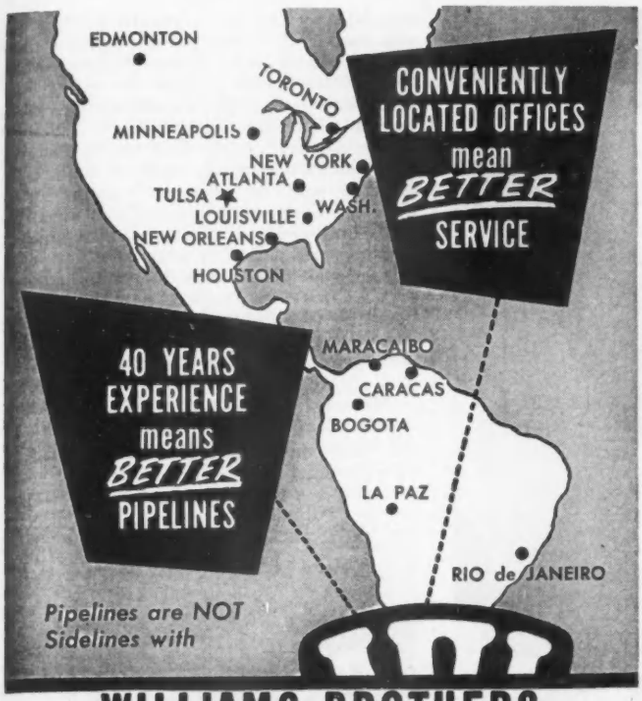
The line includes a three-point, near-bit reamer with one set of cutters for assuring full hole gage as the bit wears and for use as a fulcrum in directional drilling where drill collar support is required near the bit; a three-point regular reamer with one set of cutters in the middle of the body for reaming and stabilizing in normal drilling; and a six-point stabilizer reamer with two sets of cutters staggered so as to contact a greater section of hole. This latter is especially good for reaming just before setting pipe. Grant's nine point reamer with three sets of staggered cutters is specifically designed for straight-hole drilling in hard formations.

All Grant roller cutter reamers are designed to be run into the hole with either end up, thus making them a more versatile tool and reducing the need for subs. Also note that the cutters are set at an angle to give maximum shearing action combined with a tendency to screw out of the hole.

(This item supplements Grant Oil Tool Company data on pages 2013-2032 of the Composite Catalog, 20th Edition.)

For more data circle **No. E8** on Readers' Service Card, last page this issue.

Save time! Keep informed! Circle numbers on Readers' Service Cards, last page this issue.



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Composite Catalog, Page 3433

Write for descriptive price list.

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PRODUCTION

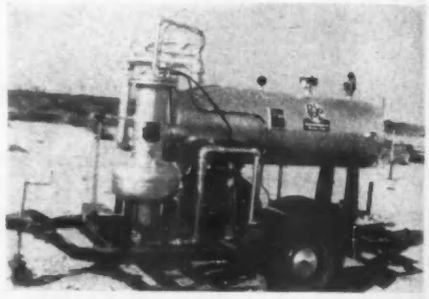
Dual String Packer

Brown Oil Tools, Inc. has introduced a new SOS detachable dual string packer. With the dual string packer each tubing string is run or pulled separately without the usual dual string clamps and extra handling equipment, effecting considerable saving in time and money. It permits permanent completion of lower zones with a full opening string with minimum or no tubing weight. The possibility of complicated fishing operations is eliminated. The detachable string packer is run in with one string, then the second string is run independently and automatically latches into and packs off in the packer without rotation. A 45 degree concave surface at the top of the packer guides the string into place and only right hand rotation is required to release the string.

The advantages of dual string installations include leaving mud in the casing annulus with no pressure existing other than the hydrostatic head of the mud column. Both zones can be handled separately so they are never thrown together. Subsurface controls are installed in both strings so they may be serviced separately. The operator is able to swab, treat or pump either zone separately without interfering with production from the other.

(This item supplements Brown Oil Tools, Inc. data on pages 837-912 of the Composite Catalog, 20th Edition.)

For more data circle **No. E9** on Readers' Service Card, last page this issue.



Wellchecker

A new Wellchecker which will automatically separate, sample, meter and record for tax and royalty records the amount of oil, gas and water from wells

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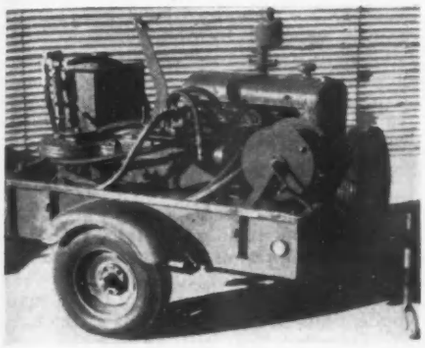
producing up to 1000 barrels per day liquid and 3000 million cubic feet gas has been added to the standard line of Wellcheckers developed by Rolo Manufacturing Company of Houston.

Equipped with the new RM 1-18 Rolocheck oil meter and Rolo automatic liquid sampler, the new unit is known as the Rolo Wellchecker No. 1H-2406-18. Crude from the wellhead is separated into three phases of oil, gas and water in the Wellchecker. Oil flows from the separator into the Rolocheck meter, where it is accurately measured and is automatically sampled while meter is dumping.

Connections are provided for free water knockout, using a Rolocheck RM 1-18 water meter which has a weighted float. Equipped with 1½-inch oil lines and three-inch gas run, the unit is completely piped, ready to operate. API-ASME code labeled. This new Wellchecker is mounted horizontally on a balance level-load trailer and the entire unit weighs 1800 pounds.

For more data circle **No. E10** on Readers' Service Card, last page this issue.



Hydraulic Tubing Tong

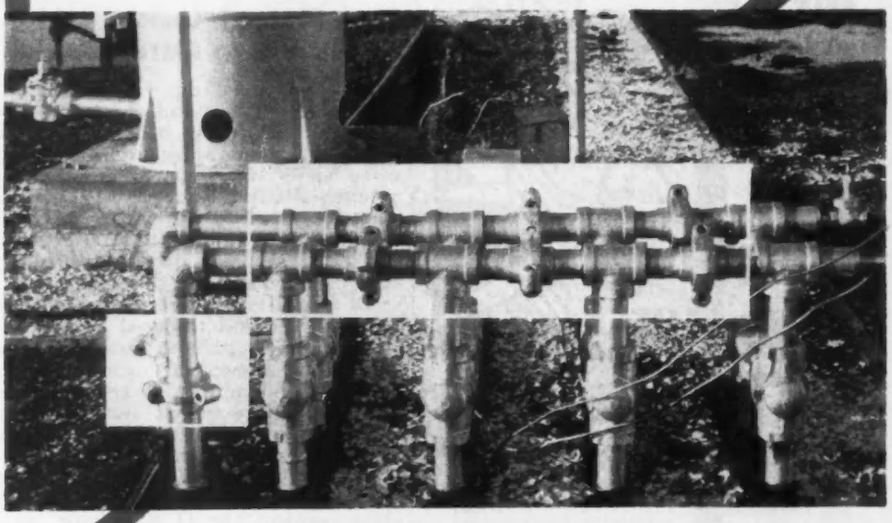
In recent demonstrations in the Permian Basin using the regular well servicing crews, new achievements in speed with safety have been accompanied with the new Foster trailer mounted hydraulic tubing tong. Average time for break-out with the Foster tong was seven seconds, while the joint make-up average was five seconds. These tong demonstrations took place on wells ranging from 4500 feet to 13,000 feet. No adjustments or mechanical failure were experienced during the trips. The Foster tong has many important safety features and all moving parts are enclosed. The 500-pound tong stays on the tubing for the entire trip and the fatiguing labor is taken out of joint breaking. The Foster tubing tong is counter-balanced when installed and easily moved up and down to permit the unlatching of the elevators—it need never be removed from the string of tubing. Two speeds are provided and may be shifted smoothly at full speed with friction clutch.

A continuous torque indication protects the tubing threads. Five gripping dogs grip the pipe without damage. The dogs disengage instantly from the tubing when the hydraulic motor is reversed. Fully portable trailer mount enables shuttling the complete equipment from location to location.

(This item supplements Foster Cathead Company data on pages 1673-1696 of the Composite Catalog, 20th Edition.)

For more data circle **No. E11** on Readers' Service Card, last page this issue.

PERFECT CONNECTIONS



for a PRODUCTION HEADER

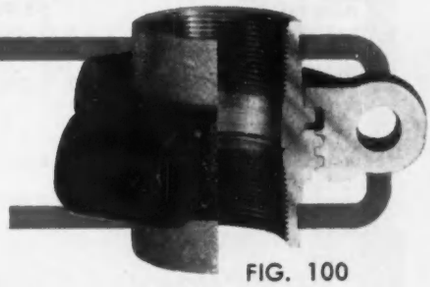


FIG. 100

WECO UNIONS

• **Perfect because these WECO Fig. 100 Unions make-up easily and quickly—because their ball and cone seat seals, and stays sealed —because the "Bar-Nut" permits tightening with an ordinary bar or hammer.**

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New Equipment Literature

Forge Steel Union and Check Valve Data Booklet

Complete data on various types of forged steel unions and check valves are contained in a new booklet now being issued by Clayton Mark & Company. Cutaway views and sectional drawings supplement detailed descriptions and specifications, including tabulated dimensions, weights, pressures and temperature ratings and other pertinent data of each type of forged steel union and check valve.

Of special interest are the pages devoted to the recently introduced "Petro" 304, 316, and 347 stainless steel hot forged unions for screwed or socket weld connections. Similar data is given for stainless steel orifice unions and forged steel union check valves with various trims, also for all brass spring check valves.

"Handle-Bar," 4000 test and 6000 test, unions are given full treatment in this new data booklet. The O Ring type, recommended for cementing, mud, crude oil, gas and water services, has recommendations given as to various type of synthetic rubber compounds best suitable for such applications.

To get a copy, circle **No. E12** on Readers' Service Card, last page this issue.

Equipment Catalog

The Guiberson Corporation has announced a new catalog for the years 1955 and 1956 which contains full descriptions, detailed engineering data, complete parts price lists and numerous illustrations of Guiberson equipment.

The cataloged data is confined to essential information and every listed item is priced and identified by individual part number. Exploded parts drawings assist in quick identification of replacement parts.

This catalog may be obtained by writing The Guiberson Corporation, Dallas, Texas, or by request from any Guiberson sales representative.

Power Booklet

Reliable lease-pump power is the title of a new booklet depicting the use of Caterpillar diesel engines and electric sets used in lease pumping.

The booklet stresses dependability and economy of operation whether Cat diesel engines are used for prime movers or for single or multple electrified or mechanical pumping units. Photographs of actual pumping sites are contained in the booklet showing Cat engines to be all-weather, round-the-clock performers. This booklet, which again stresses Caterpillar's policy of having "part service as close as your phone" is available now.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

Engineering Irons

A 28-page basic reference bulletin presents the many valuable characteristics of modern nickel cast irons and illustrates their many applications throughout industry. Twenty-seven tables, charts and photomicrographs show how through the use of nickel alone or in combination with other alloying elements, the engineering properties of cast iron can be controlled to meet service requirements.

To get a copy, circle **No. E15** on Readers' Service Card, last page this issue.

Protective Clothing

Frog Brand protective and safety clothing, products of H. M. Sawyer & Son, Company are described in a new catalog recently released by the company. This catalog lists the basic properties of the various types of Sawyer clothing as well as illustrating and describing the many available garments. Samples of the different types of treated cloth are also included in the catalog.

The H. M. Sawyer & Son Company are also manufacturers of Tuff-Tarp, a specially developed industrial fabric designed for greater abrasion resistance, as well as to withstand temperature extremes. This rugged industrial fabric should find many applications in the industry. It is especially recommended for use as derrick wind breakers and machinery covering.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Compressor Bulletins

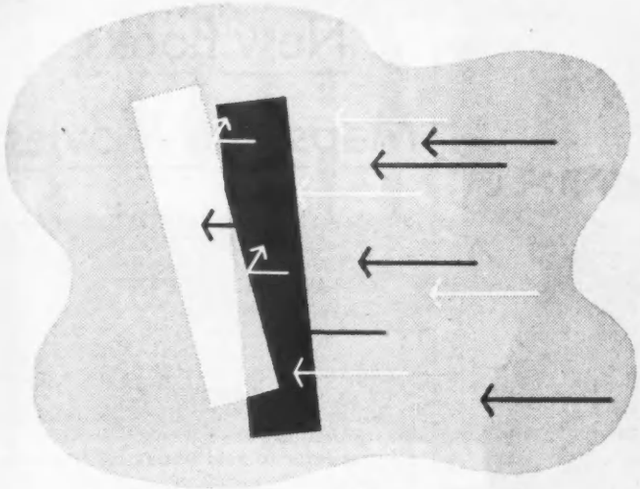
Clark Bros. Company has recently released a new catalog covering the Model TLA turbocharged compressors, together with a bulletin containing an article written by one of Clark's design engineers.

Fully illustrated, the catalog points out many of the features of this new development in two-cycle, right-angle, gas engine-driven units. Also included in the catalog is a large cut-away drawing of the Model TLA which should prove valuable for engineering study and analysis.

The bulletin contains an article, "Recent Advances in Engine and Compressor Design," by C. A. Chamberlain, describing the history, reasons for, and the problems in designing turbo-chargers for two-cycle engines. The methods of operation and the resulting efficiency increases are also dealt with in the article.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Circle numbers on Readers' Service Cards, last page this issue.



Radioisotope Laboratory For Oil Industry Opened in Houston!

A radioisotope laboratory solely for supplying the petroleum industry with special tagged compounds has been opened in Houston at 2419 South Boulevard by Tracerlab, Inc. The laboratory will stock and ship on 24-hour notice all the short lived isotopes and standard tagged chemicals now being extensively used, and will thus overcome present serious delivery problems.

Tracerlab has been supplying compounds to oil companies for several years from its Boston, Massachusetts and Richmond, California laboratories. The growing volume of orders has made it practical to establish a special laboratory in a location more convenient for the majority of users.

Many standard compounds utilized by the oil industry are to be packaged and sold under the firm's trade names: TraceSols, which are radioisotope solutions or volatile or gaseous compounds; and TraceOids, which are radioactive isotopes in the form of particulates. These compounds can be shipped on 24-hour notice or less, if the ordering firm's general authorization from the Atomic Energy Commission is on file.

Descriptive sheets on TraceSols and TraceOids, complete with specifications, prices and illustrations of some of the applications, are available on request.

HOUSTON LABORATORY
2419 South Boulevard, Houston, Texas, Tel.: Jackson 9401

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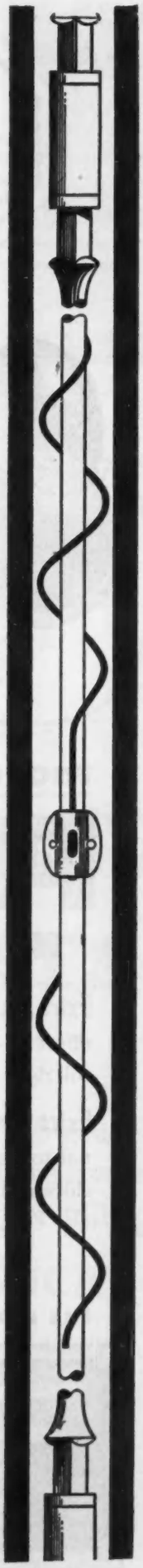

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PROPOSED STANDARDIZED LABORATORY PROCEDURES FOR SCREENING CORROSION INHIBITORS FOR USE IN OIL AND GAS WELLS, Technical Unit Committee T-IK on Inhibitors for Oil and Gas Wells, National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. 50 cents.

Information on investigations of laboratory procedures for screening corrosion inhibitors prior to field testing for use in the oil and gas producing industry is presented in this report. Static oil and water tests are proposed utilizing weight loss of a mild steel coupon exposed in inhibited solutions compared to weight loss in unhibited solutions of synthetic sour (containing hydrogen sulfide) brine. Copies are available postpaid, remittance in advance.

•

INDEX TO TOPOGRAPHIC MAPPING IN MONTANA, Montana Bureau of Mines and Geology, Montana School of Mines, Butte, Mont.

The U. S. Geological Survey has designated the Montana Bureau of Mines and Geology as an authorized map agent for the distribution of topographic and geologic maps of the state of Montana. Available for free distribution are a limited number of the Index. Copies may be secured by writing to the Office of the Director at the above listed address. The Montana Bureau of Mines and Geology is one of the few such agencies established by the U. S. Geological Survey for map distribution. Maps will be sold at cost. The Montana Bureau of Mines and Geology has received a complete set of all topographic maps of Montana except for those which are out of print.

•

SUMMARY OF WATER-FLOOD OPERATIONS IN ILLINOIS OIL POOLS DURING 1953, Illinois State Secondary Recovery and Pressure Maintenance Study Committee, the Illinois State Geological Survey and the Secondary Recovery Division of the Interstate Oil Compact Commission, Headquarters Office, Box 3127, Oklahoma City 5.

The Interstate Oil Compact Commission announces the publication of a new pamphlet on water-flood operations for the State of Illinois. This report supplements four previously issued reports of water-flood operations in Illinois.

•

OIL DIRECTORY OF TEXAS FOR 1955, R. W. Byram & Company, Drawer M, Capitol Station, Austin, Texas. $10.

This discovery lists those companies only which are paying taxes to the state of Texas as producers, processors or purchasers of oil, gas or products in Texas. The companies listed produce in Texas more than half the oil and gas produced in the U. S. It includes 5032 oil producing companies, 2094 gas producing companies, 140 oil purchasing companies, 375 gas purchasing companies, 81 refining companies, 27 carbon black plants, 187 cycling plants, 27 repressuring plants. The directory is designed for producers and buyers of oil and gas, equipment suppliers, drilling contractors, oil field service companies, lease traders, royalty buyers and abstractors.